A PROJECT REPORT ON

URBAN ISSUES AND MITIGATION MEASURES:

THE CASE OF DEVELOPED CITIES

SUBMITTED IN PARTIAL FULFILMENT FOR THE AWARD OF

BACHELORS OF ENGINEERING IN CIVIL ENGINEERING

MUMBAI UNIVERSITY, MUMBAI

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2020-2021

CERTIFICATE

This is to certify that the thesis entitled, **"URBAN ISSUES AND MITIGATION MEASURES: THE CASE OF DEVELOPED CITIES"** submitted in partial fulfilment of the requirements for the award of **Bachelors of Engineering** degree in **Civil Engineering** during 2020-2021 session at Anjuman I Islam's Kalsekar Technical Campus, New Panvel, is an authentic work carried out under my supervision and guidance.

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PROJECT APPROVAL SHEET

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DECLARATION

We declare that this written submission represents ideas in our own words and where others ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that; we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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CONTENTS

ABSTRACT

URBAN POPULATION has been sharply growing since last several decades, and the rate of growth has been steadily increasing due to various factors such as economic reasons. In the future, not only the population in cities but also the number and size of cities are expected to grow. This profound growth in urbanization is imposing several serious problems on human and earth, such as pollution, deforestation and food scarcity. In our project, to learn and understand about such problems, we have selected a few cities from different parts of the world and assessed them on a wide spectrum of various parameters ranging from land use to transportation to architecture to environment and sustainability. Based on this research, we have selected a few urban problems, such as lack of open spaces, for further analysis. Then, we have studied about some cities which have successfully tackled these problems. Finally, we have presented a comparison of the selected cities highlighting the similarities and differences between them in a tabular format.

CHAPTER 1: INTRODUCTION

For the first time in human history, most of the world's population lives in a city. And the world's urban population is expected to rise sharply in the future. By 2050, about two-thirds of the world's population will live in cities and there will be more very large cities than ever before.

Urban population has grown from 35% of the global population in 1960 to more than half the world's population in 2014, and has been rapidly expanding due to population growth, urbanization, industrial development and other factors.

In the year 2010, the world's population was about seven billion people, almost exactly half of whom live in cities. It is projected that the world's cities will add about 700 million residents every decade. The largest increases in urban populations will occur in Asia and Africa, especially in poorer countries. Asia is expected to nearly double its number of urban dwellers, from about 1.7 billion in 2009 to 3.4 billion in 2050.

Not only is the world's urban population expected to rise very rapidly, but the number and size of the world's very large cities also are expected to increase dramatically in the coming decades. The term megacity refers to an urban area with a population of more than 10 million people. In 1950, there were just two megacities: New York City and Tokyo. By 2009, there were about 20 megacities, including three with populations of more than 20 million.

By the year 2025, there are likely to be 30 or more megacities, some of which will have populations over 25 million people. Tokyo, Delhi, and Mumbai are all expected to have populations over 25 million and even the 12th largest megacity, Kinshasa, will have a population of more than 15 million people. Most of the world's megacities will also be in poorer countries — including Bangladesh, Pakistan, and Nigeria — where tens of millions of people manage to survive on just a few dollars a day.

This urban expansionism has had profound consequences on issues of global interest, such as land use, human development, and climate change. Moreover, the patterns of urban development across the world, though similar in many ways, are distinct and are shaped by the socio-economic, cultural, geographic and other needs of the cities.

World urban growth trends will create lots of challenges for urban planning around the world, ranging from providing enough decent housing and clean water for billions of new urban dwellers to successfully managing the local and global environmental impacts of the planet's skyrocketing urban population.

In our Project, we intend to critically assess selected capital cities on certain urban, architectural and environmental issues; and suggest remedial measures to various problems associated with urban planning, along with suggestions to enhance the overall features of a city.

Some small examples of threats and solutions in urban cities are as follows:

Problem	**Solution**
Intensive urban growth can lead to greater poverty, with local governments unable to provide services for all people	Counter poverty by promoting economic development and job creation.
Concentrated energy use leads to greater air pollution with significant impact on human health	Reduce air pollution by upgrading energy use, use of renewable source of energy and alternative transport systems.
Large volumes of uncollected waste create multiple health hazards.	Create private-public partnerships to provide services such as waste disposal and housing.
Animal populations are inhibited by toxic substances, vehicles, and the loss of habitat and food sources.	Plant trees and incorporate the care of city green spaces as a key element in urban planning.

CHAPTER 2: METHODOLOGY AND LITERATURE REVIEW

LITERATURE REVIEW

A state-of-the-art literature review was carried out as part of the present study and brief summary of sources is highlighted. In these papers, the urban features of the selected cities are studied in depth and the information obtained from these sources is discussed in the following chapters.

We have compiled information from the following sources:

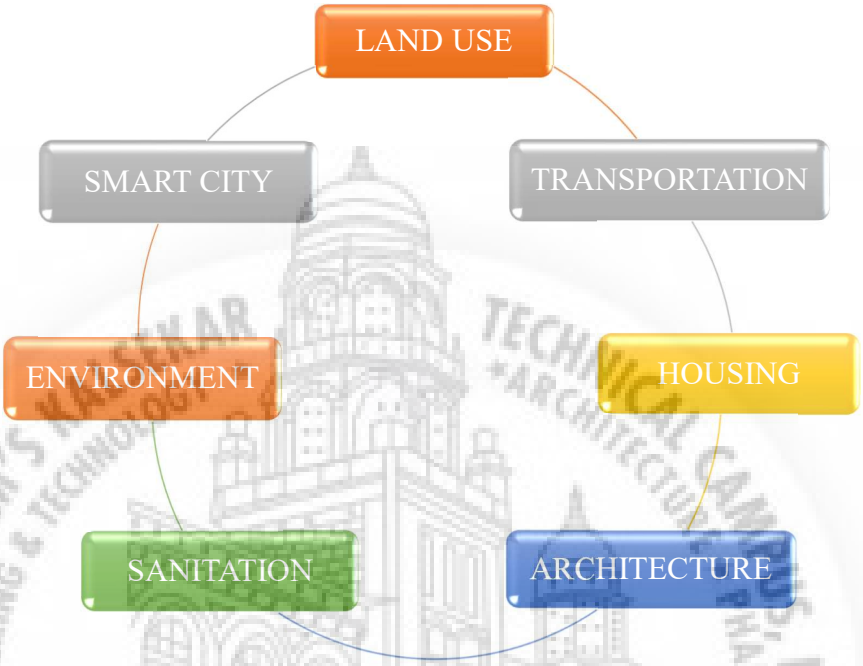
1. Government development plans
2. Case studies available on the internet
3. Research papers
4. Websites of government and private organizations
5. Educational videos and other relevant content available online

The detailed list of references is provided in the appendix.

METHODOLOGY

- Selection of Parameters
- Analysis of Cities
- Identification of Urban Issues
- Case Studies on Selected Issues
- Comparison of Cities
- Mitigation Measures

For our research, we have analyzed cities on the basis of certain urban parameters. The major parameters we have selected for assessment are as follows:



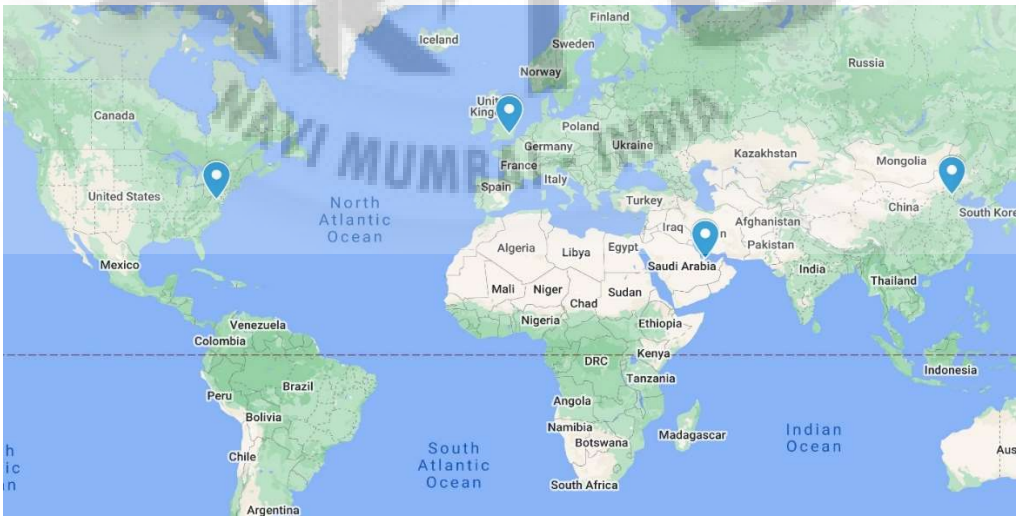
These topics are further divided into sub-topics as follows:

Land Use	Land Use Classification
	Zoning Laws
	Open and Green Spaces
	Cultural Places
	Industrial Area
Transportation Infrastructure	Road System
	Travel time And Congestion
	Rapid Transit System
	Cycling Infrastructure and Walkability
Housing	Types of homes
	Affordability in Sale and Rent prices
	Homelessness rate/ Slums

Architecture and Urban design	Styles of architecture
	Historical Development
	Features of Traditional architecture
Sanitation Facilities	Water Supply
	Sewage Management
	Solid Waste Management
Environment and Sustainability	Climate Change
	Green Buildings
	Energy Efficiency
	Pollution
Smart City Initiative	Future and Present plans

We have selected four cities from different parts of the world for our analysis. While selecting the cities, we kept the following features of city in mind:

1. Population
2. Land Use
3. Economy
4. Environmental threats

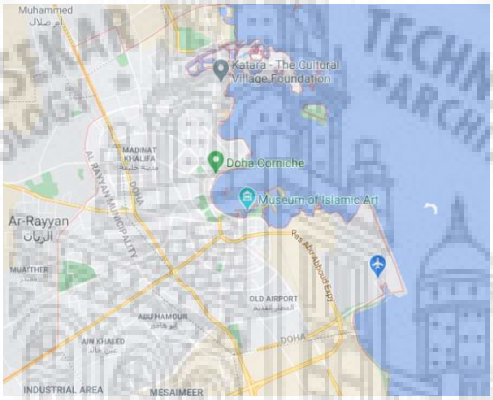


Picture: Location of Cities

The cities we have selected for our assessment are as follows:

1. Doha, Qatar: Located in Middle East (Asia)

Doha is the capital of 'Qatar'. It is a modern and rapidly developing city, and considering the money being poured into construction, Doha looks set to become one of the premier cities in the Gulf within a few years. Doha is located on the coast of the Persian Gulf in the east of the country. Doha ranked as the second safest city in the world in 2021.



Picture: Doha, Qatar

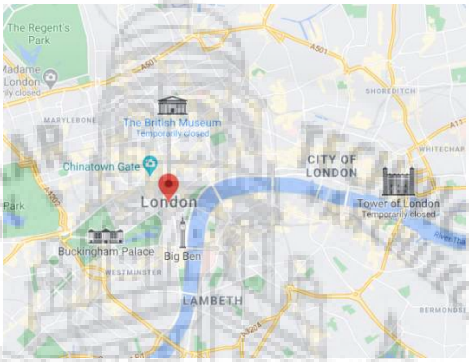
2. Beijing, China: Located in Asia

Beijing is the capital city of people's Republic of China. It is the world's most populous national capital city, with over 21 million residents. Beijing Municipality currently comprises 16 administrative county-level subdivisions including 16 urban, suburban, and rural districts.

Picture: Bejing, China

3. London, United Kingdom: Located in Europe

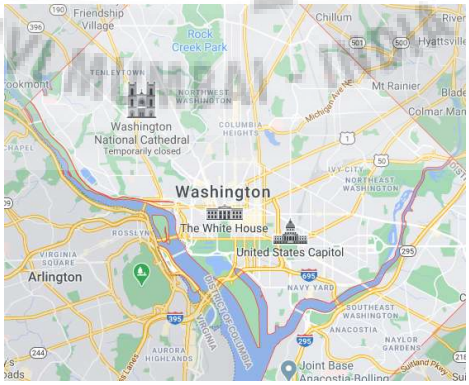
London is the capital and the largest city of United Kingdom. London is famous for more than its magnificent ancient buildings, the Palace of Westminster, Trafalgar Square, Tower of London, London Eye, Art Galleries, and Big Ben. London's economy contributes majorly in the whole United Kingdom's GDP.



Picture: London, UK

4. Washington, D.C., United States of America: Located in North America

Washington, D.C., is the capital city of United State of America. It is a district of Columbia. Washington has a growing, diversified economy with an increasing percentage of professional and business service jobs. Between 2009 and 2016, GDP per capita in Washington has consistently ranked on the very top among U.S. states.



Washington D.C., USA

As urbanization is on its peak, needs of people increase due to which various problems arise in urban development. Poor air and water quality, insufficient water availability, waste-disposal problems, and high energy consumption are exacerbated by the increasing population density and demands of urban environments. Strong city planning will be essential in managing these and other difficulties as the world's urban areas swell.

Based on our analysis of the four cities, we have recognized certain urban issues in the following areas and have prepared case study reports on each of them as follows:

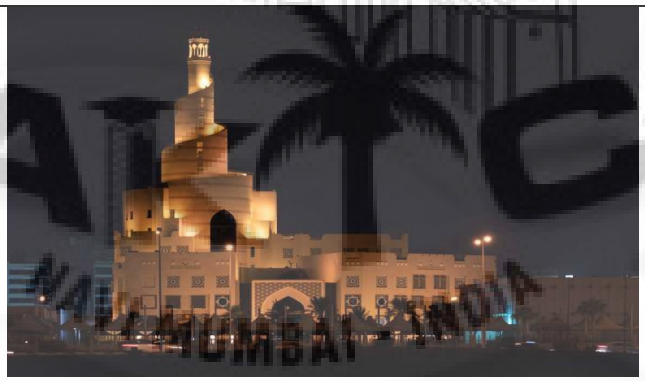
Area	Issue	Relevant Case Study
Green spaces	Lack of Green Spaces in Densely Populated Cities	Paris, France
Cultural places	Neglect of Cultural Heritage	Beirut, Lebanon
Industrial Areas	Adverse effects of Industrialization on human and environment	Mumbai, India
Solid Waste Management	Challenges and solution for urban development of the city	Mumbai, India
Climate Change	Rehabilitation of a micro-central hydroelectric installation	Nueva Alianza, Guatemala
Homelessness	Supported accommodation and Homelessness Services	Illawarra, New South Wales of Australia

CHAPTER 3: ANALYSIS OF DOHA CITY

3.1 Introduction

Doha was founded in the 1820s as an offshoot of Al Bidda, and grew inwards from the Arabian sea coast. It was officially declared the country's capital in 1971, when Qatar gained independence from being a British Protectorate. Doha is the largest city, and the administrative and economic center of the country. Most of the geographically compact country consists of low, barren desert. The climate is hot and humid from hot in summer and cool in winter, with precipitation being scarce.

As one of the emergent financial centers in the Middle East, Doha is now considered a beta-level global city. In 2017, Qatar's total population was 26 lakhs: 3,13,000 Qatari citizens and 23 lakhs expatriates. Around 80% of this population lives within the Doha metropolitan area.



Name of City: DOHA
Country, Continent: Qatar, Asia
Area: 421 km^2

Population: 10,78,410 (within Municipality) 23,82,000 (Metropolitan Area)
Population Density: 18,000/km^2
First Settled: 1825
Declared capital in: 1971 (Upon Independence)
Planned / Unplanned: Planned City
Government of country: Monarchy
Elevation above MSL: 10 m
HDI (and HDI Rank) of Country: 0.848 (41st Rank)
Nominal GDP per capita of Country: $138,910 (1st)
Languages: Arabic, English

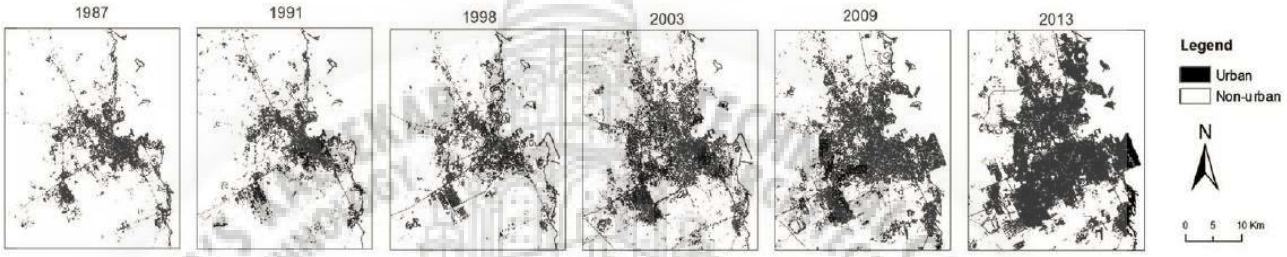
3.2 Land Use

3.2.1 Land Use Classification

	1987	1991	1998	2003	2009	2013
Total urban (km2)	106.02	113.24	120.23	225.80	284.76	421.17
Total vegetation (km2)	11.19	7.47	18.76	25.58	13.84	22.01
Ratio between vegetation and urban (%)	10.56	6.60	15.61	11.33	4.86	5.23
Estimated population (in thousand)	225	246	274	322	760	991
Urban area per capita (m2)	470	460	439	702	375	425

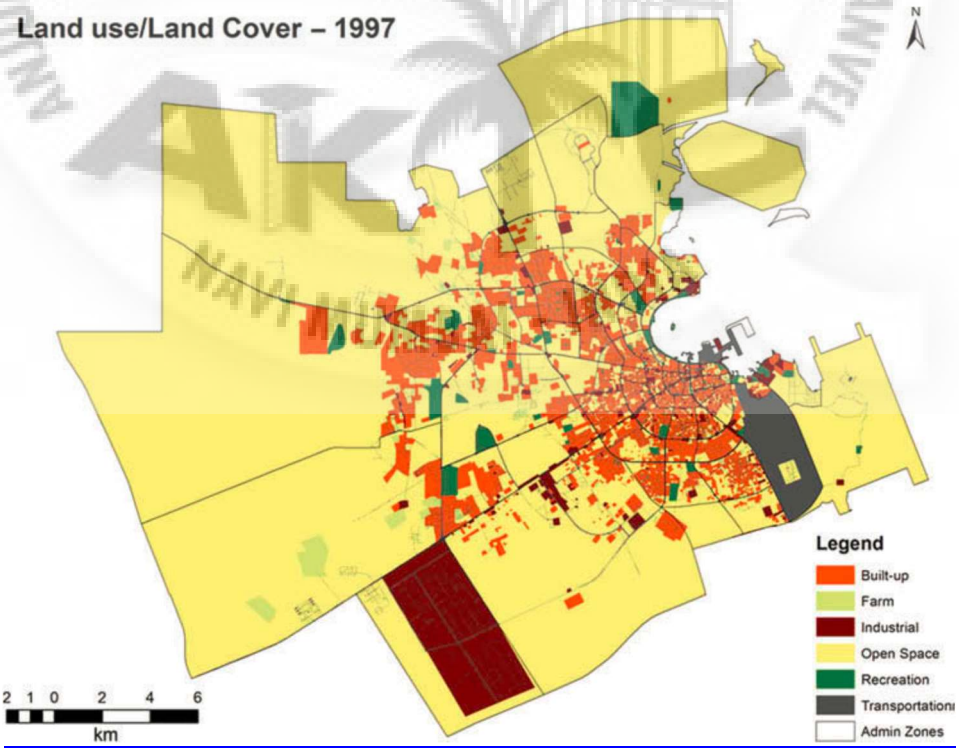
Table: Increase in urban area, vegetation and population over the years

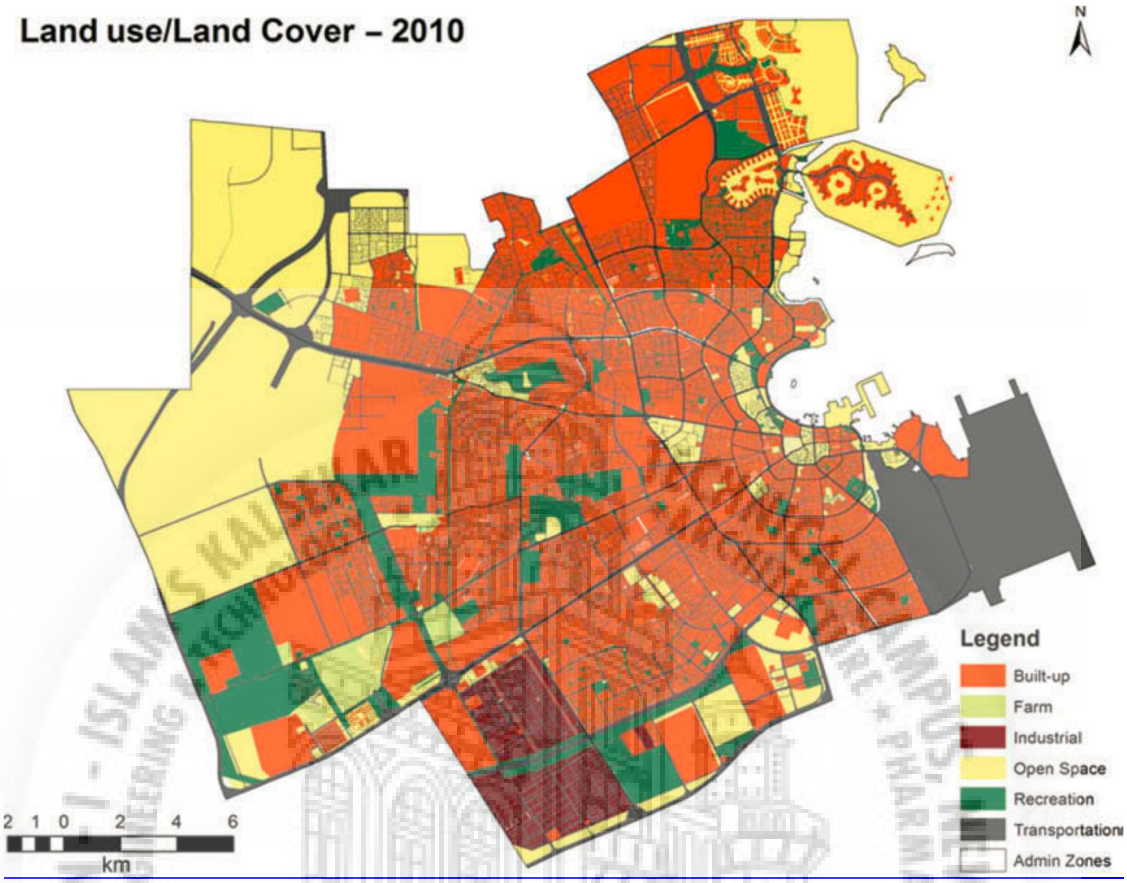
In terms of observed land cover change, the patterns of growth were largely urban, which grew four times (106km^2 to 421km^2) over the study period. Results indicate that early in the process of development, between 1987 and 1998, the Doha region grew outward, resulting in an overall increase in the distance between development areas. The region has also infilled during the study period which suggests that formerly disparate areas were brought together by development of the urban infrastructure.



Picture: Urban Growth of Doha City over the years

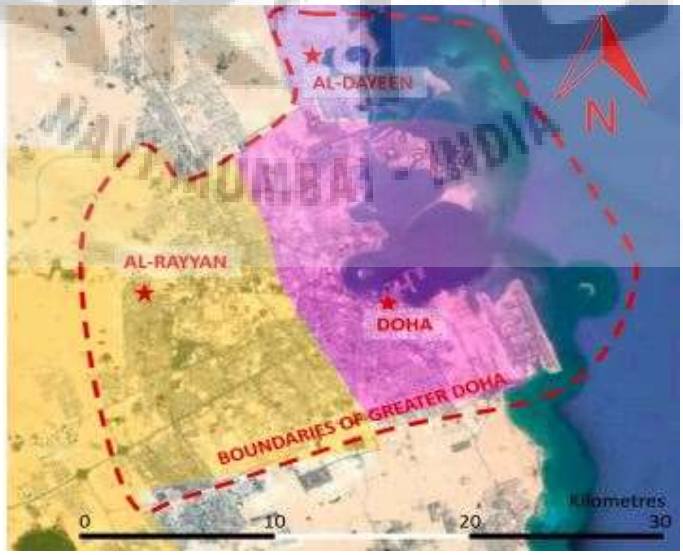
Doha's current stage of urban development patterns is a product of many co-occurring factors, including the creation of an international hub for education and sports, and liberalization and decentralization process at the start of the millennium, intended to accelerate urban growth.





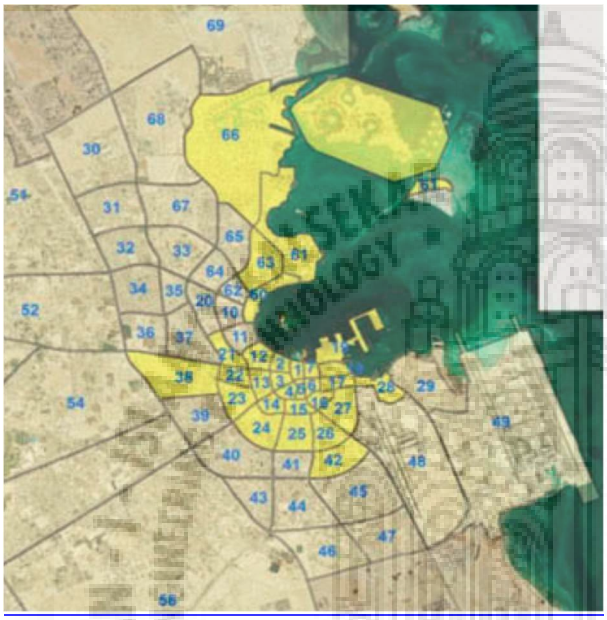
Pictures: Comparison of Land Use under various heads between 1997 and 2010

3.2.2 Governance and Municipality, Zoning Laws



Picture: The metropolitan consists of 3 municipalities: Doha, Al Rayyan and Al Daayen

The Urban Planning Department of the Central Ministry of Municipality and Environment is responsible for zoning activities, such as (i) development of urban development strategy, (ii) preparation of urban plans, pertinent to the cities, urban and rural communities, and (iii) preparation of planning criteria and regulations for all planning patterns of the land uses.



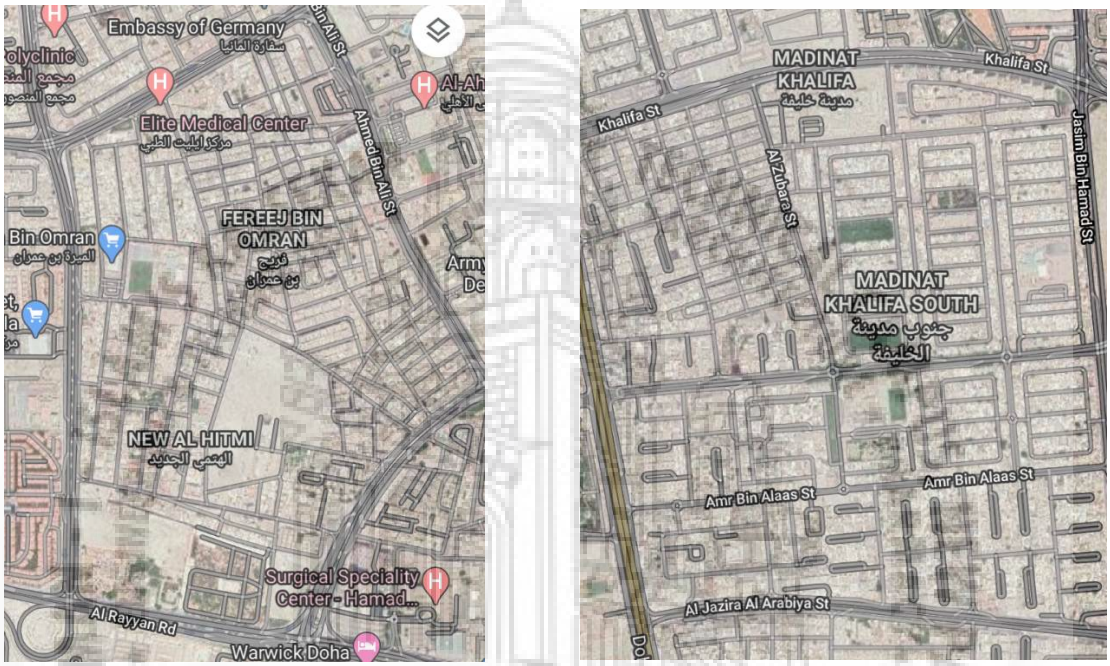
Pictures: The various planning zones in Doha city, sample informatory signboard showing zone number

The zones highlighted in yellow colour in the above figure are the zones of high-rise constructions, reflecting the higher population density in downtown Doha.

The executive Zoning Regulations have been divided into three sets of zoning requirements: **Group (1)** consists of 21 separate Planning Zones, which include various types of residential, industrial and Public Facilities as well as other activities, for instance tourism and agriculture. **Group (2)** includes 7 special planning Zones, "Overlays", which deal with development applications that are located within the boundaries of areas of special sensitivity and status such as heritage, coastal and airport areas, etc. **Group (3)** includes 15 sets of planning & design guidelines such as Community Facilities and Open Space & Recreational Facilities.

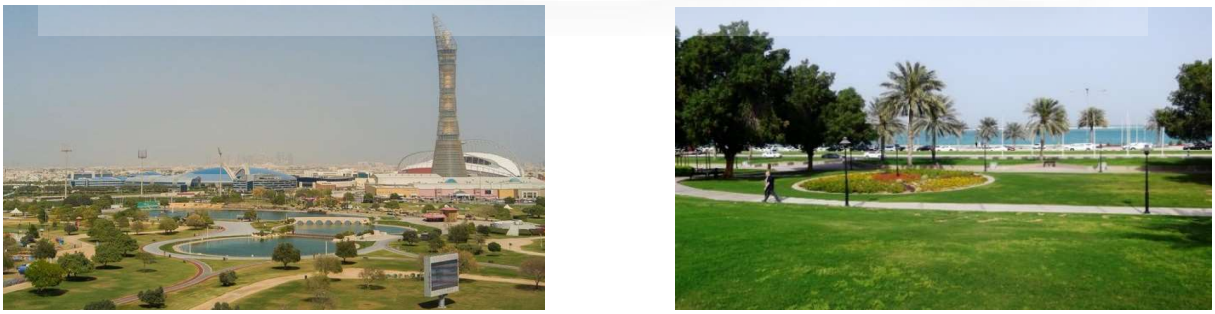
3.2.3 Open and Green Spaces

The total vegetation in 1998 was approximately 19km^2, 1.7 times that of 1987, but increased only slightly to 22km^2 by 2013. The proportion of vegetation in comparison to urban area decreased from 11% in 1987 to 5% in 2013.



Pictures: Sample residential zones show a lack of open public spaces, except for football fields

There is a general lack of developed open public spaces and gardens at the zonal level. A significant percentage of vacant land remains undeveloped and unavailable for appropriate urban redevelopment inside the municipality, despite the continuing outward urban expansion of Metropolitan Doha. Most of the open spaces provided is generally in the form of football fields. However, the city has a few large public parks, such as Aspire Park and Al Bidda Park.



Pictures: Aspire Park (with Aspire Tower-Doha's tallest in the background) and Al Bidda Park

Scarcity of fertile land and water imposes limitations on agriculture, and a large proportion of the country's food must be imported. Use of treated sewage effluent and desalinated water for irrigation, however, has helped expand the production of fruits and vegetables, which Qatar now exports to other countries.

3.2.4 Cultural Places

Souq Waqif

Built on an ancient market site, the vibrant complex remains the social heart of Doha. Centuries ago, Bedouin would bring their sheep, goats and wool here to trade for essentials, and the entire market area has been cleverly redeveloped to look the part of a 19th-century souq, with mud-rendered shops and exposed timber beams, plus some authentic and beautifully restored original Qatari buildings.

Pictures: Souq Waqif-the central cultural and marketplace of Doha, and the Museum of Islamic Arts (right)

Museum of Islamic Arts

Designed by world-renowned architect I.M. Pei, the MIA building draws influence from traditional Islamic architecture. The geometric patterns of the Islamic world adorn the inside space, making for a grand interior. A variety of textures and materials, including wood and stone, of periods from 7th to 19th century, have created a unique environment for the museum's stunning collections.

3.2.5 Industrial Area

While heavy industries, such as metal production and petrochemical are situated far from the city in areas like Mesaieed industrial city, an industrial zone has been established in the outskirts of the city for light and medium projects. It includes all services (visible and non-visible) like roads, lighting, gas, sewage and an integrated service facility.

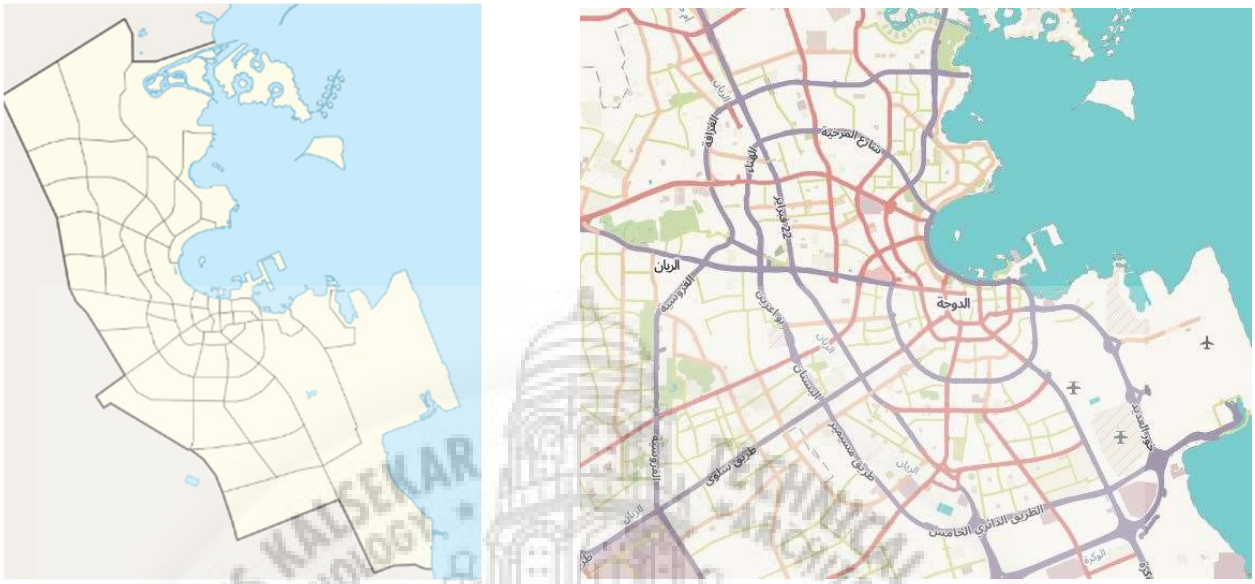
Picture: Overview of Doha Industrial Zone and location on Map

Qatar has enjoyed an average economic growth rate of over 15 % in the last decade as a result of rapidly increasing LNG exports and high petroleum prices. The economy relies heavily on exports of natural gas exports and products manufactured with low-cost natural gas, such as urea, steel, and petrochemicals.

3.3 Transportation Infrastructure

3.3.1 Road System

The road system in Doha is in the form of Radial Ring Roads. The concentric structure that dominated the early expansion of the city is still visible today in the urban form with the ring roads and radials forming key elements in the city's legibility.



Pictures: Generalized and map view of the Radial Ring Roads

The five ring roads- named A-ring road, B-ring road, C-ring road, D-ring road, and E-ring road control the traffic circulation inside the city.

3.3.2 Travel time and Congestion

The average number of extra hours spent due to traffic congestion were 92 hours per commuter in 2019, according to the Qatar Traffic report 2020.

Picture: Growth in number of personal vehicles has led to deteriorating traffic over the years

In the high-density areas of downtown Doha, high levels of population growth due to immigration have resulted in a degraded built environment and increased vehicle congestion. All five ring roads currently suffer from heavy congestion and traffic volumes during peak hours. The Public Works Authority has in recent years undertaken many developments to ease traffic, including the installation of traffic signals at vital points instead of roundabouts.

3.3.3 Public Transport System

Public Bus

Public transportation in Doha, emerged in 2004 with the introduction of the public bus system. Originally operated on restricted routes, the system has slowly expanded in an attempt to reduce the number of vehicles moving in Doha. As private vehicles play a vital role in daily lives of the city's residents and fuel is cheap, there is lack of incentive for the general public to use public buses.

Pictures: The routes of Red, Green and Gold Lines (Phase I) and the locomotive in operation

Doha Metro

Phase One of Doha Metro became operational in 2019. The new rapid transit network is expected to provide an efficient and reliable public transport system. The metro project has GSAS 5-Star and LEED Gold awards. The majority of the metro infrastructure is underground in tunnels. The Red and Green lines also include elevated and at-grade sections.

Capable of reaching 100 km/h, the Doha Metro is one of the fastest driverless trains in the world. Once fully operational, the metro is expected to feature a network of 300km with four lines named Red, Green, Gold and Blue. Approximately 60 additional stations are expected to be added to the city metro network by 2026.

3.3.4 Cycling Infrastructure and Walkability

Cycling Infrastructure

Due to the scales being designed for vehicular transport, cycling is not very popular in the city. In addition, high summer temperatures, lack of connectivity and adequate facilities hinder the prevalence of this mode of transport. The Qatari capital is already working on plans to set up bike lanes by refitting the existing roads to allow bicycle rides and increase safety for cyclists. Roundabouts, a major feature in Doha roads, however remain a strong challenge.

Picture: Sample bike lanes in Doha, problems of inaccessible sidewalks hamper walkability

The Qatar National Bicycle Master Plan envisions a network of bicycle facilities and set of programs to be completed over the next 10 to 20 years to make Qatar the number one cycling community in the world. The plan recommends bicycle facilities that provide access to all areas of Greater Doha, linking to schools, parks, stadiums and future transit stations.

Walkability

Pedestrian connectivity and legibility within the city is severely constrained. The streets are designed for cars. As a result of the design favoring motorized transport, scales are inappropriate for pedestrians and the navigation and signage are aimed for cars only. Most sidewalks are neither properly designed nor enhanced enough for a pleasant walking experience. No shades or street furniture is provided to enhance the walking experience.

The traditional urban patterns (e.g. pedestrian streets, sikkat) that reflect the Qatari past and Arabic culture, have been lost to car dominated roads and indiscriminate parking that create pedestrian impassable barriers which isolate residents from community services. The city planners should aim to encourage walkability by prompting a model inspired by the past that is compact, mixed-use, diverse, transit-friendly, and takes into consideration a hierarchy of buildings and places.

3.4 Housing

Population

As of August 25th, 2019, the population of Qatar is 2,839,386, based on the latest United Nations estimates, making it the 141st most populous nation on the globe.

3.4.1 Types of Homes

Out of around 300 thousand housing units in the country, almost half fall in the category of Flats or Apartments. Palaces and Villas constitute about one third of the total housing units whereas the Arabic or Popular/ Elderly houses share has got reduced to less than 10 percent. The majority of housing units in Doha are flats or apartments followed by villas and Arabic houses.

Picture: Typical multi-storied residential building and standalone Villa in Doha

The average number of people living in one building is growing, which indicates a gradual shift towards multi-storey and high-rise living style. Comparatively in 1990s, the great majority of buildings in the urban landscape of Greater Doha was traditional Arabic style of low-rise buildings (G and G+1 style).

3.4.2 Affordability in Sale and Rent Prices

A commonly accepted guideline for housing affordability is when accommodation costs are within 30% of a household's gross income. In the income and expenditure survey by the Qatar Statistics Authority (2012/2013), expatriate households spend 34% of their income on housing. This percentage is only likely to increase in the future given the acute undersupply in the market.

Doha's housing market has been affected by an acute shortage for years. Growth in housing stock fails to meet the growing number of households. The number of households has risen considerably in recent years, due to a sharp rise in the growth of the population.

3.4.3 Homelessness rate/ Slums

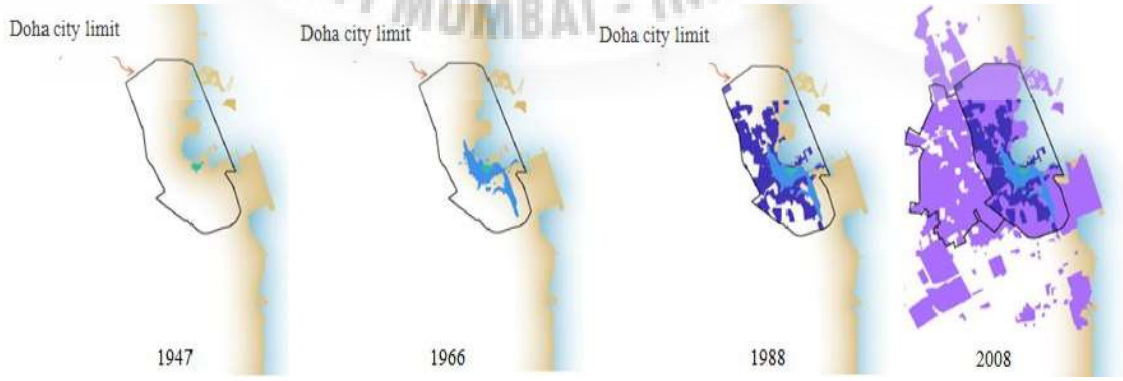
Rising rents, influx of migrant workers to build new projects, and continuing invisibility of the migrant workforce has resulted in a number of homeless workers in Doha. Increasing costs of living for rents, utility bills, basic foodstuff, while contending with stagnant salaries, have pushed low-income migrant workers to live in even more desperate living conditions.

Pictures: Migrant labours often have to reside in poor and unhealthy living conditions

The government effectively bans ‘bachelors’ (low-income male migrant workers) from living in residential areas, where families reside. To commute to the city for work from ghettoised locations (‘labour camps') in the outskirts is not affordable to those workers who don’t receive company transportation, as public transport in the country is negligible. Hence, surreptitiously run bed spaces within the city is in high demand and expensive.

3.5 Architecture and Urban design

In the past few years and as a result of the dramatic increase in national income that has accompanied the development of the oil industry, Doha has undergone immense changes in its social, economic and physical environments. In less than half a century, the country has been transformed from a nomadic and subsistence farming economy into a modern urban/industrial society



Picture: Urban sprawl of Doha City over the decades

3.5.1 Styles of architecture

Doha blends vernacular architecture with new, modern buildings. In the midst of the high-rise towers that make up the West Bay area skyline, each building has a different story to tell with its intricate and unique design.

Pictures: Panaroma of the West Bay commercial district, with Doha Tower (centre) and Tornado Tower (right) in closeup

Two of the most innovative and conspicuous structures that immediately catch the eye are Doha Tower and Tornado Tower. Doha Tower is one of the city's most iconic buildings. Its cladding is meant to mimic the traditional Islamic "mashrabiya," or artistic screen used for shading or dividing a room. This tall cylindrical structure has won awards for its innovative design, such as the CTBUH Skyscraper Award for the Best Tall Building Worldwide in 2012. The design also echoes the design and shape of bird towers built of mud and clay that still exist in parts of Qatar.

In contrast, Tornado Tower is more modern in design and does not have a clear connection to Qatari heritage. The Tornado Tower, which, as its name suggests, is meant to resemble a tornado, has been touted for its unique yet simple design. The tower tapers inward at the mid-point and then outwards again at its highest point.

In the early stages of Doha's development, it was a challenge for both local and foreign architects to reflect the identity and heritage of the country and balance it with the functional, climatic and sustainable demands of massive-scale buildings. However, now with a greater focus on preservation of identity, Doha is witnessing the birth of distinguished and unique Arab architecture.

3.5.2 Historical Development

In earlier times, homes were built based on the inherited knowledge of the indigenous population using local building materials such as palm leaves, stones and mud. Residential buildings were low-rise, spacious courtyard houses. The design followed the Islamic tradition of dividing male and female spaces, which was further visible in the alleys within neighbourhoods ("fereej).

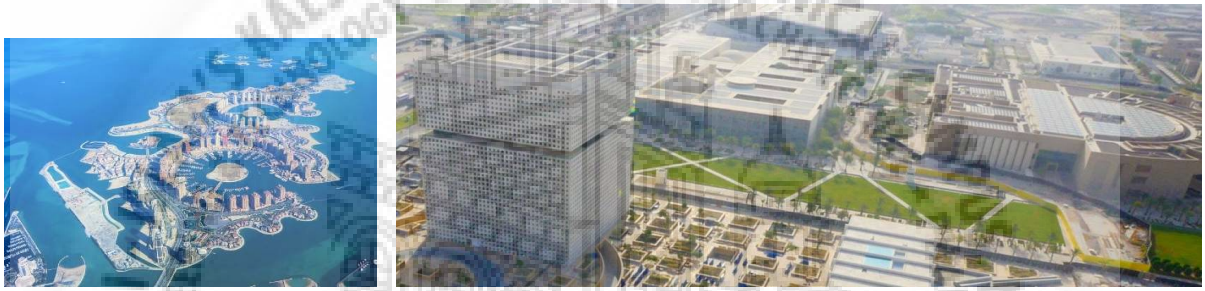
Pictures: Homes in older times in Doha

During the 1950s and 1960s, settlement patterns were determined by the development of modern infrastructure such as roads and the supply of fresh water and electricity. Subsequently, roads were widened in central areas to provide access by car and the old courtyard buildings were replaced by modern building blocks made of cement and stones.

In 1972, the British consultant Llewelyn Davis was appointed by the new town planning authority within the Ministry of Municipal Affairs and Agriculture to design the first masterplan of Doha. His plan was based on a ring concept with a clear definition and functional distribution of land uses regarding

In the 1980s and early 90s, modernization of the city was rapid, which was reflected in the architecture and urban design of the period, which broke away abruptly from the vernacular to principles imposed by the state. This can be seen best in the replacement of the traditional neighborhoods of the indigenous population, with modern suburban dwellings that stood on equally sized rectangular plots accessed by an orthogonal grid of roads. The Western consultants who advised this process applied their Western understanding of modern space to the modernization of Doha, which at that time considered the car to be the main means of transport. Thus, Doha developed into a car-based city incorporating geometrical grids with various road hierarchies and space for roads and parking sites.

Since the turn of the millennium, Doha's urban growth has been progressing at a much faster rate, which is attributed to a transition from oil-based toward a competitive and more complex globalized economy. As a result, Doha begun to emerge as a global center for media, education, culture and finance through huge investments and several initiatives such as the Al Jazeera Channel, the Doha Economic Zone, the Education City, Qatar Foundation for Education, Science and Community Development and the "Pearl Island" reclamation project. This was accompanied by a construction boom that erected skyscrapers, sport facilities, shopping malls, gated communities and iconic museums and libraries.



Picture: "Pearl Qatar" Reclamation Project and overview of Education City

3.5.3 Features of Traditional architecture

Traditional buildings are the stringing identity of any country. This direction goes with what Qatar Vision 2030 is about: Preserving Qatar's national heritage and to enhance Arab and Islamic values and identity.

The traditional Qatari wall

Ordinary natural mud is usually used while putting courses of strong and solid stone walls. The walls of the building are covered from inside and outside with mud, or mixed with plants such as grass or hay to prevent cracks due to desiccation, rain water, wind and other atmospheric elements.

Pictures: Examples of mud wall in traditional Qatari architecture

The Wind tower

It was used as a ventilation system that catches the air and distributes it to different spaces of the buildings.

Picture: The idea and examples of wind tower in Qatari traditional buildings

Wall alcoves or recess

They are horizontal wall cuttings made of carol bricks "fouroush" quarried from the sea shore. It was an economic and easy way and used for making wall openings for light and ventilation.

Picture: Alcoves and recess in traditional Qatari architecture

Doors and Windows

The wooden door is popular in Qatari traditional buildings. The windows were rectangular recesses. All round the window from the outside, there was a wooden frame with a horizontal wooden board in the middle. This horizontal board divided the frame into two equal rectangular halves-upper and lower.

Picture: Traditional door and window openings

3.6 Sanitation Facilities

3.6.1 Water Supply

Doha has one of the highest consumption of water per capita per day, around 400 litres. The city relies on seawater desalination as the primary source for drinking water and on groundwater abstraction for agricultural purposes. About 400 million cubic meters per year of desalinated water was delivered in 2012. Roughly 5 kWh of electricity is needed for each cubic meter (1,000 litres) of fresh water produced.

As per data from Water Statistics report, 100% of the population is using safely managed drinking water services, while Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene is 0 per 100,000 persons.

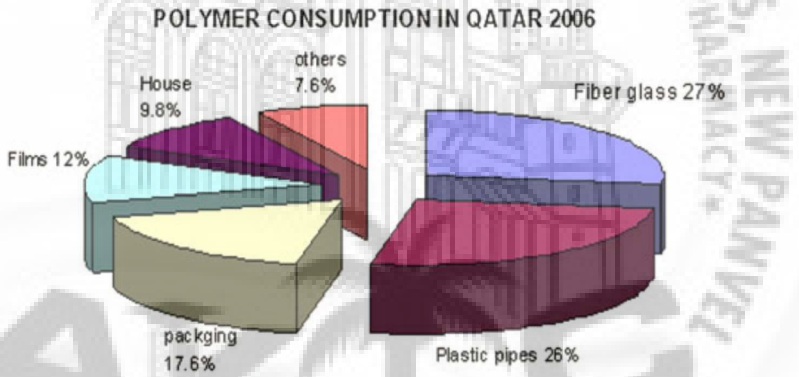
3.6.2 Sewage Management

The sewage treatment plant in Doha uses primary, secondary and tertiary treatment units for treating predominantly domestic sewage. The stabilized sludge is used as a soil conditioner. The re-use of treated wastewater has become an important alternative source of water for agricultural and green spaces irrigation.

The raw sewage is characterized by high dissolved solids, medium strength BOD, low COD/BOD ratio, high concentration of chloride, sulphate and sulfide due to septic sewage. These are typical characteristics of the sewage in this region. The reclaimed water quality meets the international standards and guidelines for landscape irrigation and farming. No evidence of disease amongst workers or the public has been observed from the water reuse.

3.6.3 Solid Waste Management

The city has one of the highest per capita waste generation rates worldwide which is as high as 1.8 kg per day. Doha produces more than 2.5 million tons of municipal solid waste each year. Solid waste stream is mainly comprised of organic materials (around 60 percent) while the rest of the waste steam is made up of recyclables like glass, paper, metals and plastics.



Picture: Plastic Use classification in Doha

The predominant method of solid waste disposal is landfilling. The collected is discharged at various transfer stations from where it is sent to the landfill. There are three landfills in Qatar; one for bulky and domestic waste, one for construction and demolition waste, while the other is for sewage wastes.

A comprehensive solid waste management plan is being implemented. The target is to recycle 38 percent of solid waste, up from the current 8 percent, and reduce domestic per capita waste generation.

3.7 Environment and Sustainability

In 2008, Qatar launched its National Vision 2030 which highlights environmental development as one of the four main goals for Qatar over the next two decades. The National Vision pledges to develop sustainable alternatives to oil-based energy to preserve the local and global environment.

3.7.1 Climate Change

Qatar is ranked first in the world in term of CO2 emissions per capita. Reducing the dependency of economic growth on oil & gas and increasing the green area would help in enhancing the air quality and reducing CO2 emissions.

One of Doha's most prominent efforts in the field of climate change is the project of using compressed natural gas (CNG) as a fuel in the transport sector. It aims to develop CNG as an alternative fuel in public transport applications. This project provides increased fuel security and allows the reduction of greenhouse gas emissions. Qatar's launch of solar power station is also an important step towards diversifying the country's electricity production sources and increasing reliance on renewable energy sources.

3.7.2 Green Buildings

Qatar is ranked second on the list of Middle East countries with most number of LEED certified buildings, with 173 green buildings. Qatar has established its own assessment system called Global Sustainability Assessment System (GSAS). GSAS is billed as the world's most comprehensive green building assessment system and was developed after rigorous analysis of 40 green building codes from all over the world.

GSAS is assessed on the following eight categories; urban connectivity, site, energy, water, indoor environment, materials, management and operations and cultural and economic values. Qatar has incorporated GSAS into Qatar Construction Standards 2010 and it is now mandatory for all private and public sector projects to get GSAS certification.

Sustainable development has been identified as one of the top priorities in Qatar's National Development Strategy, with the objective of reducing the overall impact of the built environment on human health and the natural environment. This can be promoted by using water, energy and other resources more efficiently as well as ensuring occupant health and improving employee productivity.

Picture: Qatar National Convention Center with its rooftop solar panels is a shining example of Green Building

The Qatar National Convention Center has been accredited for its approach to environmental stress mitigation. The 177,000 square meter structure is considered as one of the world's most iconic energy-efficient convention centers built to date. The building has 3,500 square meters of its roof areas with solar panels, contributing 12.5% of the building total electrical consumption.

3.7.3 Energy Efficiency

Per-capita electricity consumption in Doha is among the highest in the world, about 14,400 kWh/year. Energy efficiency policies and measures are at an early stage in Qatar. Conventional tariff-based strategies to discourage wasteful use of energy and water will be less successful in Qatar because Qatari citizens are extremely wealthy and are entitled to free electricity, water, and natural gas.

The electric and water utility company, Kahramaa, has announced plans to reduce electricity

consumption by 20 % and water consumption by 35 % in the next five years. In practice, however, only a few mandatory efficiency regulations have actually been implemented, especially with respect to buildings.

3.7.4 Pollution

Picture: Dust storms are a common sight in summer months

The level of air pollution in Doha is very alarming as it has frequently exceeded local and international recommended standards. In fact, compared to the world health organization's (WHO) standards of the 24-hour and annual averages concentration of 50 µg/m3and 20 µg/m3 for PM10, Qatar's national air quality standards are far from these values. For instance, the values for PM10 is around 150 µg/m3 for 24 hours' average concentration and around 50 µg/m3 for the annual average concentration. These high levels have increased the likelihood of diseases related to the respiratory system such as asthma, chronic obstructive pulmonary disease among many others.

3.8 Smart City Initiative

Challenge faced: High heat in summer climate

Measure taken: Application of "cool pavement pilot project" to reduce overall temperature

Picture: The "blue cool" pavement

The Public Works Authority in Doha (Ashghal) has implemented a pilot cool pavement project in Doha, which involves the use of a cryogenic material to reduce the temperature of the asphalt on roads. The asphalt cryogenic material was piloted in August 2019 on to 200 meters of vehicle lanes in Downtown Doha and also on 200 meters of pedestrian and bicycle paths.

Unlike conventional asphalt, which contributes to increased temperature by absorbing up to 80 to 95 percent of sunlight, cooling pavement reflects UV rays and absorbs solar radiation to a lesser extent and can have a positive effect on overall temperature reduction. Besides, its protective material reduces vehicle tire friction and increases life of roads.

Picture: At outside temperature of 40 °C, the temperature of blue cryogenic coated pavement was measured to be around 58 °C, while that of ordinary asphalt pavement was 65 °C.

The pilot project will last for 18 months and based on the outcome, it will determine its wider applicability. Research findings suggest that the use of cool pavement can reduce overall temperature and thus reduce emissions. Furthermore, by lowering air temperatures in residential areas, cool pavement can slow chemical reactions in the atmosphere that cause smog. Research works also suggest that cool paving material reduces heat-related illnesses, enhances pedestrian ability to use the road and promotes traffic safety, as light colored pavements reflect street lights and front car lights better, making vehicles more visible to their drivers.

3.9 Conclusion and Lessons learnt

- In the past 5 decades, Qatar and its capital city Doha have transformed from a simple desert habitat to the richest country in the world by GDP per capita, due in no small part to the oil and gas industry.

- This transformation has brought about an explosion of population, expansion of urban built up area, and significant changes in the architectural designs and socioeconomic indicators.

- Due to outward growth of the city to account for population growth, there has been an increase of 4 times in the urban area in the period 1987-2013.

- Planning zones are divided into 3 categories: First includes Residential, Industrial and Urban areas. The second group includes areas of sensitivity such as that of heritage value. The third group includes community and recreational facilities.

- There has been a modest increase in green cover in last three decades. Moreover, the proportion of Green areas in comparison to Urban areas has decreased. There is a lack of developed open public spaces at the zonal level.

- Some of the recreational spaces are Souq Waqif and Museum of Islamic Arts, while popular shopping malls are City Center and Mall of Qatar.

- The economy relies heavily on exports of natural gas and petrochemicals. An industrial zone has been established in the outskirts of the city for light and medium enterprises.

- Football is the most popular sport in Doha, and construction of several football stadiums is underway in preparation for FIFA World Cup 2022.

- The road system in Doha is in the form of Radial Ring Roads. The major roads suffer from congestion due to increase in number of vehicles in the city. However, the government has undertaken several initiatives such as construction of new roads to counter this.

- As fuel is cheap there is a lack of incentive for the residents to use Public buses. Phase one of the metro became operational in 2019, and is expected to provide an efficient public transport system. The metro project has GSAS 5-Star and LEED Gold awards.

- High summer temperatures, lack of connectivity and adequate facilities have prevented cycling from being a popular mode of transport. However, the government has established ambitious plans to popularise cycling. Pedestrian connectivity within the city is severely constrained. The streets are designed for cars.

- Almost half of the total houses in the city are either Flats or Apartments, with significant numbers of villas and Arabic houses. Rent prices continue to be exorbitantly high in Doha due to shortage of houses and high demand from Expatriate population. Labours and construction workers to some extent face issues of homelessness and are sometimes housed in inadequate accomodation.

- Doha has undergone immense changes in its social, economic and physical environments in recent times. The high-rise buildings in Doha show a variety of architectural styles, such as western and Arab architecture. The traditional Qatari wall, the wind tower, and wall alcoves are some of the features of Traditional Qatari architecture.

- Qatar has its own Green Building assessment system called "Global Sustainability Assessment System (GSAS)", and is ranked second in the Middle East in number of green buildings.

- Per-capita electricity and water consumption in Doha are among the highest in the world. Tariff-based strategies are less successful as Qataris are extremely wealthy.

- 100% of the population is benefitted with potable water supply and sanitation facilities. Commercial water supply is obtained through desalination, which is an energy intrusive process. Doha also has the highest per capita sold waste generation rate worldwide, which is as high as 1.8 kg per day. Landfilling is the primary method of solid waste disposal.

- The level of air pollution in Doha is very alarming as it has frequently exceeded international safe standards.

- One of the smart city initiatives in Doha involves the application of “cool pavement pilot project” to reduce overall temperature.

CHAPTER 4: ANALYSIS OF BEIJING CITY

4.1 Introduction

Beijing is the current capital of China and one of its ancient capitals. The name "Beijing" means Northern Capital. Beijing is also known as Peking.

Beijing is not only the nation's political center, but also a cultural, scientific and educational heart as well as a key transportation hub. Beijing has served as a capital of the country for more than 800 years. The city has many places of historic interest and scenic beauty, including the Forbidden City - the largest and best-preserved ancient architectural complex in the world; the Temple of Heaven - where Ming and Qing emperors performed solemn rituals for bountiful harvests; the Summer Palace - the emperors' magnificent garden retreat; the Ming Tombs - the stately and majestic mausoleums of 13 Ming Dynasty emperors; and the world-renowned and genuinely inspiring Badaling section of the Great Wall. Large-scale construction has brought great changes to Beijing since the foundation of the People's Republic of China in 1949 that adds more and more new attractions to the mysterious old city. The city also has a character all its own; there are quadrangles, Hutongs, tricycle, boiled mutton, arts and crafts, roasted duck and Peking Opera.


Name of City: Beijing
Country, Continent: People's Republic of China, Asia
Area: 16,808km^2
Population: 20,462,612 (Beijing at 22 June,2020)
Population Density: 1,247/km^2
First Settled: 1045 BC (Zhou Dynasty)
Declared capital in: 1971 (Upon Independence)
Planned / Unplanned: Planned City
Government of country: Municipality
Elevation above MSL: 44 m
HDI (and HDI Rank) of Country: 0.752 (86th place in table of 189 countries)
Nominal GDP per capita of Country: 8130 USD
Languages: Standard Chinese(Mandarin), Yue(Cantonese)

Geography

Lying in the northern part of North China Plain, Beijing is surrounded by mountains on the west, the north and the northeast. The northeastern part of the city is high while the southwestern part is low topographically. Beijing has a continental monsoon climate with four distinct seasons. Spring and autumn are short while winter and summer are long. Average annual rainfall in 2002 equaled 370.4 millimeters, which was relatively low.

A panorama of the Forbidden City, viewed from the Jingshan Park

4.2 Land Use

4.2.1 Land Use Classification

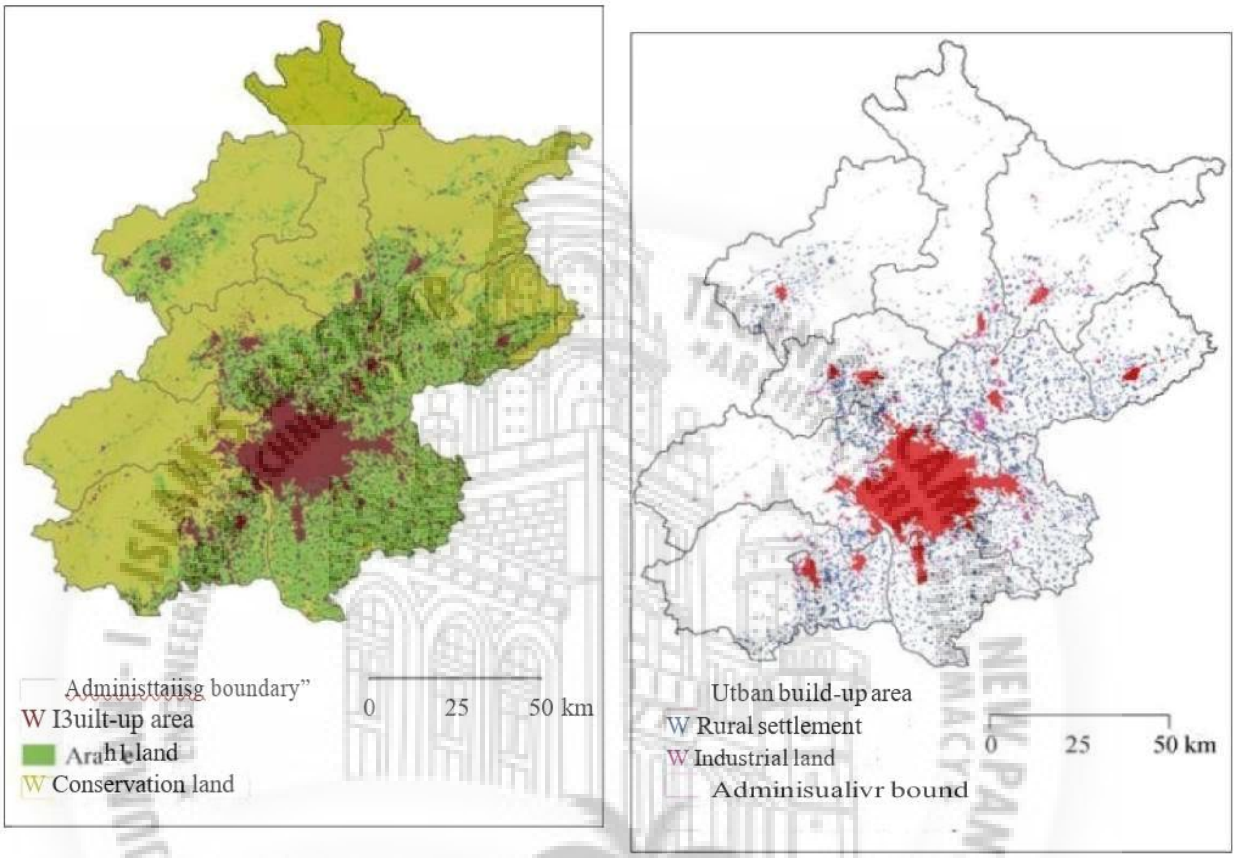


Figure 1 Spatial distribution of main land use types in Beij ing in 2OO0

Source: Data Center for Resources arid Env ironineritai Sciences {C RES), Chinese Academy of Sciences {CA S). Conser- vation land includes forest arid grassland, water and non-use land. And built-up area refers to residential area and land for stand-alone industrial arid mining sites. In

In Beijing, conservation land is concentrated in mountainous areas in the city's hinterland, while rural settlements, urban built-up areas and arable land are mainly distributed in the plains (Figure 1). Like the rest of China, one of major challenges that Beijing is now facing is how to allocate arable land, built-up area and conservation land, in order to simultaneously realize the three aims of economic development, environmental improvement, and arable land protection (Figure 3). In particular, in order to realize the total quantity equilibrium of basic farmland, Beijing has to reclaim new arable land in some ecologically fragile areas (for instance, in mountain areas and wet lands), because some farmland is being converted into forest and grassland due to the grain for green policy in other ecologically fragile areas. In the plain's farmland is being lost to built-up areas due to industrialization and urbanization.

4.2.2 Governance and Municipality, Zoning laws

Beijing Municipal Institute of City Planning & Design (BICP) is an institution affiliated to Beijing Municipal Commission of Urban Planning and responsible for the formulation of various urban and rural plans. As approved by the Ministry of Construction of China, BICP is a grade a planning and Design organization and aims to provide the services for Beijing municipal government's macro decision-making on urban development and various construction projects.

The major responsibilities of BICP are as follows:

Organize the formulation of the city master plan, district plan, regulatory plan, infrastructure plan and the transportation plan of the municipality, and undertake the planning integration for the underground pipe network. Participate in studies on social economic development strategy and important policies of urban construction for the municipality, and provide technical services such as planning research, formulation, consultation for relevant government departments and local authorities.

Undertake the technical appraisal and integration of planning, participate in the technical examination of planning schemes, and provide technical services and guarantee for planning administration.

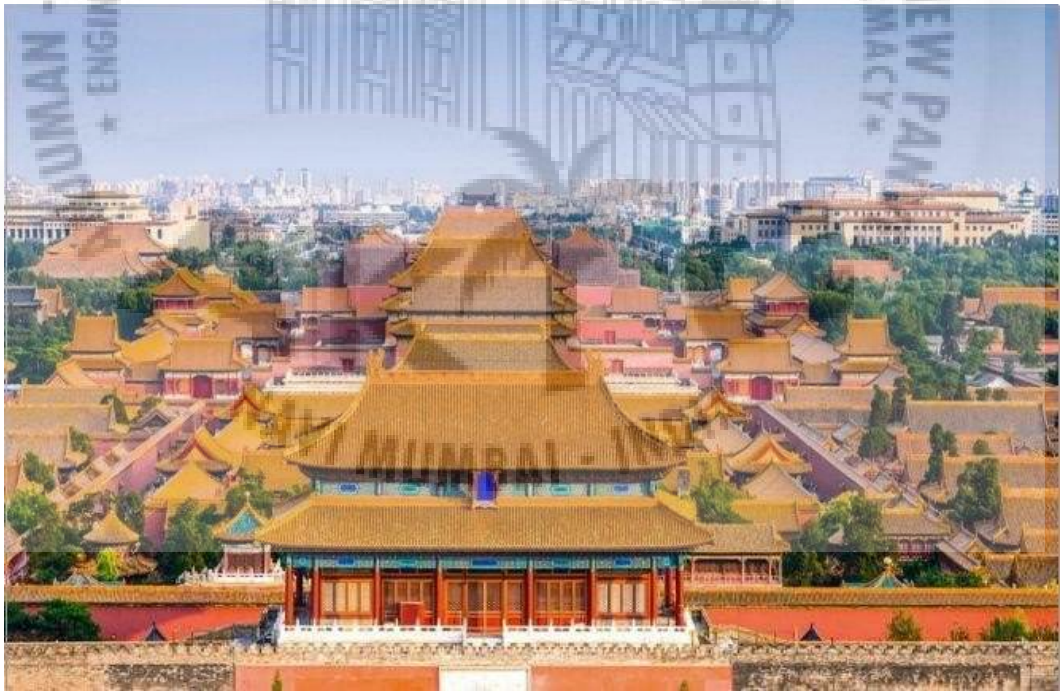
4.2.3 Open and Green Spaces

Beijing, a massive metropolis with an arid climate does not have a lot of greenery that thrives naturally in its dense gridwork. Thankfully however the earliest city planners made sure to incorporate temple parks into the capital's design. That means Beijing has many parks that are very centrally located and can be worked into most travel itineraries.

Beijing will create 600 hectares of urban green space in 2018 to improve the city's living conditions. The figure will increase the city's green coverage rate to 48.3 percent, compared to 46.2 percent in 2012 during the past five years a total of 40022 hectares of green spaces were created in capital including 150 urban parks, said Deng Naiping, head of the bureau. Most of the open spaces provided in the form of parks and temple.

The Forbidden City

Grand imperial palace deserves no other spot. Unarguably located in the center of Beijing, it has been the home to Chinese emperors since 1420 in the Ming Dynasty.



The Forbidden City

Walking past its scarlet walls and looking up at the golden roofs against the blue sky, it is as if you can still recal

The past glories of China's imperial families. If you live in Beijing, remember to visit the Forbidden City in snow because no words can describe how beautiful the scenery is.

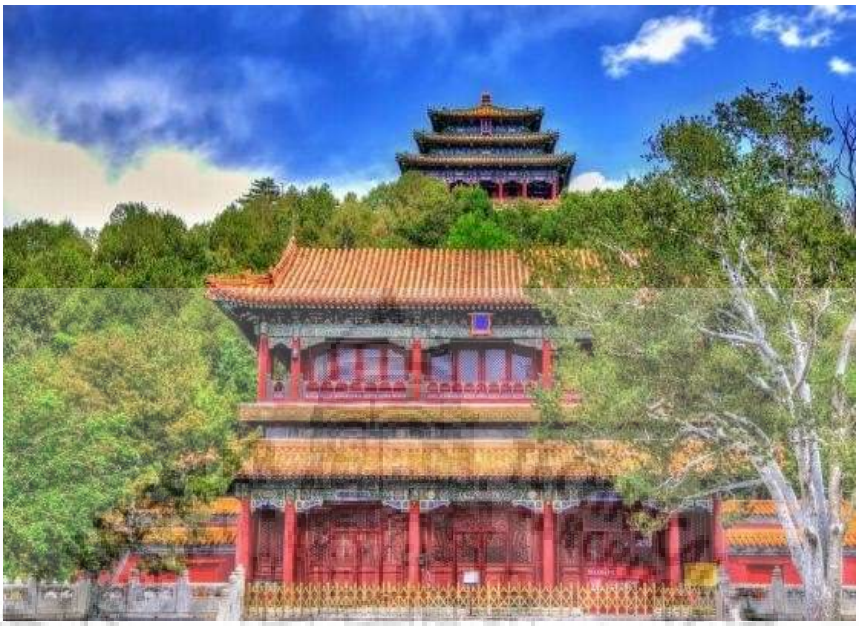
Temple of Earth (Ditan Park)

This venerable park contains the 486-year-old Temple of Earth, where Ming and Qing emperors made ritual offerings to the Goddess of the Earth every summer solstice. Ditan's square footprint is in direct contrast to the Temple of Heaven, its larger, circular counterpart in the southeastern part of Beijing. Nowadays, you're more likely to see people taking a leisurely stroll through the peony garden than engaging in worship.

Temple of Earth (Ditan Park)

Jingshan Park

This green space is located just across the street from the Forbidden City. The namesake hill (Jingshan) was created from earth excavated to form a moat around the emperor's palace and designated an imperial park.



Jingshan Park

According to feng shui precepts, harmful yin energy thought to come bearing from the north, along with cold winter winds. Jingshan Park, strategically placed at the north of the Forbidden City was thought to serve as an important "energy blockade." Head to this park on a clear day to enjoy one of the best overlooking views on the city.

4.2.4 Cultural Places/ Recreational

As the residence of the imperial families through several dynastic periods Beijing is well known for its numerous parks and playgrounds few cities in China have as large a proportion of land within the central city allocated for recreational uses. Among the most popular of Beijing's parks are Zhongshan Park, Bei Hai Park, Jingshan Park, the Summer Palace, and the Beijing Zoo

Beijing Zoo

The Beijing Zoo is located in the western part of the city. The zoo was established toward the end of the 19th century and was named the "Garden of Ten Thousand Animals" (Wanshengyuan). Its collection is actually about half that size, but it is the largest zoo in the country, with animals from all parts of China and the world; one of the zoo's most popular attractions is its collection of giant pandas.

Beijing Zoo

Buddhist Temple (The Lama Temple)

The most famous Buddhist temple outside Tibet is also Beijing's most spellbinding religious monument. Located just north of the city centre the Lama Temple attracts a steady stream of tourists to its decorative roofs colorful frescoes and giant statues of Buddha.

Buddhist Temple (The Lama Temple)

4.2.5 Industrial Development

Beijing is largely a post-industrial economy and has the biggest tertiary industry as a proportion of GDP among All Chinese cities. In 2018, Beijing's tertiary industry, or service sector, accounted for more than 80 percent of the city's GDP, While the secondary industry, or industrial and manufacturing sector, accounted for most of the remaining 20 Percent. Sector-wise, Beijing has highly-developed financial, service, R&D, cultural, and education industries. Specifically, the added value of Beijing's modern service industry – which includes financial, technology, Information services, and other advanced services – comprised around 60 percent of GDP in 2018. Income derived from cultural industries, meanwhile, reached RMB 1 trillion (US$15 billion) in that year.

4.3 Transportation Infrastructure

Beijing is an important transport hub in North China with six ring roads, 1167 km of expressways,15 National Highways, nine conventional railways, and five high speed railways converging on the city

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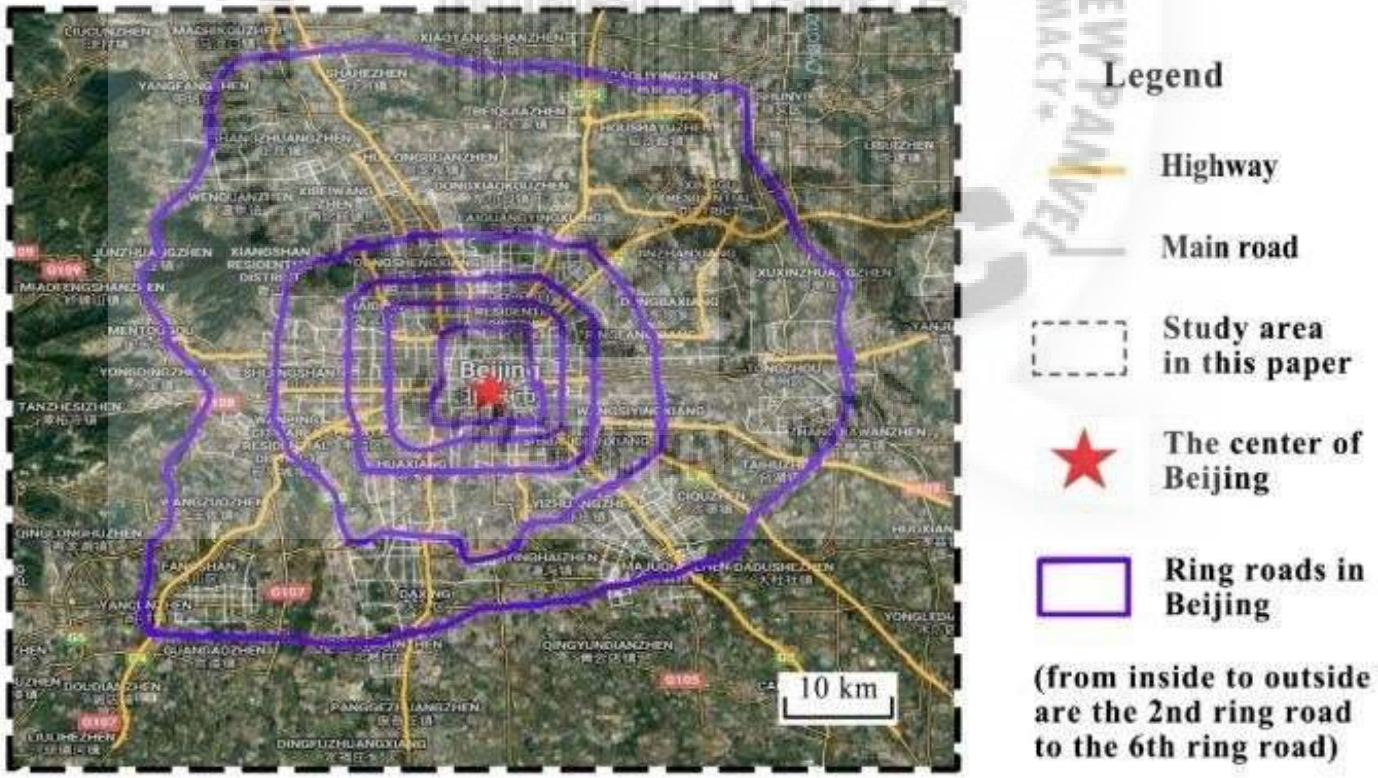
4.3.1 Road System

The road system in Beijing is in the form of ring roads (beltways) system. From the centre of city outward they are: 2nd Ring Road, 3rd Ring Road, 4th Ring Road, 5th Ring Road and 6th Ring Road.

The "1st Ring" of Beijing refers to the historic tram route (now demolished) through Xidan, Ping'anli, Di'anmen, Beixinqiao, Dongdan and Tiananmen. No ring roads are built on this route but it is still called "1st Ring". From that on ring road built on Beijing historic city limit is called 2nd Ring.



The road network (ring roads, highways, and main roads are shown)

4.3.2 Travel time and Congestion

Beijing is one of most congested cities in the world, with over 6 million car on its roads, The average number of extra hours spent due to traffic congestion were 149 hours(6 days 5 hours) per commuter in 2019, according to the Beijing Traffic report 2020.

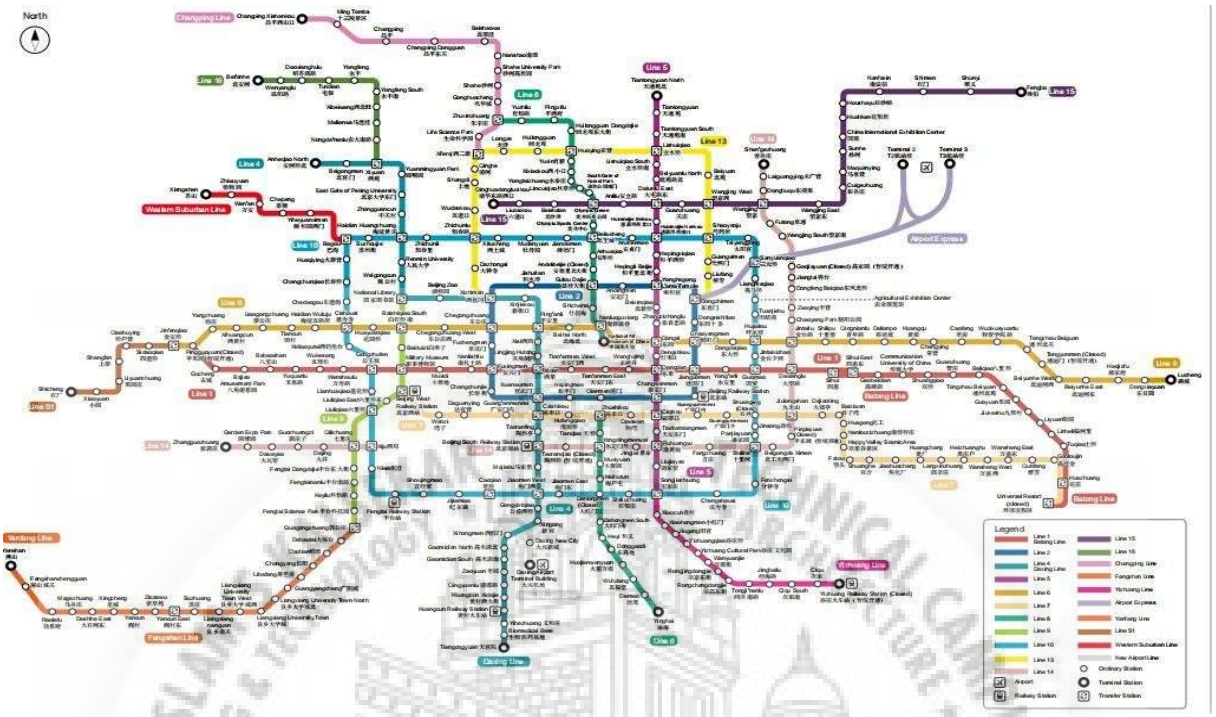
Drivers spent on average just under three hours in traffic each weekday. Data from navigation app AutoNavi shows Beijing commuters lost an average of 1075 Yuan (159$) per month due to congestion

Traffic in Beijing, china

4.3.3 Public transport System

Beijing City Subway

The Beijing Subway now has 23 lines, 678.2 km (421.4 mi) of lines and 394 stations in operation. Subway travel is generally fast clean economical and during peak periods congested. Currently About 12 million journeys are made on the subway every day. By 2020, the city predicts daily Ridership will increase to over 18.5 million journeys a day. The electronic commuter fare card, Yikatong is accepted on all lines.



Beijing Suburban Railway

The Beijing Suburban Railway, a suburban commuter train service, is managed separately from the Beijing Subway. The two systems, although complementary, are not related to each other Operationally. Beijing Suburban Railway is run as part of the Beijing Railway Bureau. There are 3 suburban railway lines currently in operation: Line S2, Sub-Central line and Huairou–Miyun line

Bus, Trolleybus and BRT

The Beijing Public Transport Holdings, Ltd. (“BPT”) is the main bus and trolleybus operator in the city. It is owned by the city and Beijing had more than 28,343 buses carrying over 13.39 million person/trips a day. Over 1,100 Dual-mode trolleybuses operate on 29 routes and are gradually being expanded to combat urban air pollution. BPT also currently operates 4 bus rapid transit lines.

The Beijing Yuntong Bus Company operates its own bus rsame fare schedule as the BPT buses same fare schedule as the BPT buses.

Beijing Bus No. 1 on Chang'an Boulevard at Tiananmen Square.

A Beijing trolleybus.

4.3.4 Cycling Infrastructure & Walkability

Beijing has long been well known for the number of bicycles on its streets. Although the rise of motor traffic has created a great deal of congestion and bicycle use has declined, bicycles are still an important form of local transportation. Many cyclists can be seen on most roads in the city and most of the main roads have dedicated bicycle lanes. Beijing is relatively flat which makes cycling convenient. The rise of electric bicycles and electric scooters which have similar speeds and use the same cycle lanes may have brought about a revival in bicycle- speed two-wheeled transport. On Mar 30, 2019, a 6.5 km bicycle-dedicated lane was opened, easing the traffic congestion between Huilongguan and Shangdi where there are many high-tech companies. Cycling has seen a resurgence in popularity.

Walkability, defined as “the extent to which walking is readily available as a safe, connected, accessible and pleasant mode of transport its important element in assessing urban sustainability, but Beijing city is not a walkable city, Beijing city is very large city and its very hard to go another place by foot or walking, In fact it can be fairly hostile to pedestrians.

The city roads and street lanes are designed for cars and bicycle, and many of the roads there is no sidewalk available. The city planner (BICP) is increasing their workability index, except central shanghai, Hangzhou.

Sample of Bicycle, Electric Bicycle and Electric Scooter Lan

4.4 Housing

Population

Beijing is the second largest city in China with over 20 million people in the urban area. Since the 1950s, Beijing's population has steadily increased from just over 1,600,000 people to the 20-odd million people who call it home today. The city's meteoric population growth shows no sign of stopping, with experts predicting that over 25 million people will live in the city's urban area by 2034.

Almost 80% of Beijing's population is working age. This is due mostly to Beijing's position as an economic powerhouse. It is believed that Beijing has been inhabited by modern humans for 27,000 years, and it is considered one of the oldest cities in the world. In fact, men outnumber women by some 70 million in China.

4.4.2 Types of Homes

Beijing is a historical city, until 1949 Beijing was a completely traditional courtyard city, rapid economic growth coupled with an unprecedented level of real estate development have almost wholesale destruction of traditional siheyuan courtyard houses. Now most of the houses in city are flats and apartment only 10 to 12 percent houses in city are traditional which includes historical temple, park etc.

Traditional siheyuan courtyard houses

4.4.3 Affordability in sale and rent prices

There are many desirable areas and suburbs to look for Beijing apartments for rent. The average one-bedroom apartment in Beijing ranges from €450-€800 per month depending on location. The majority of Beijing's expat populations live in the eastern part of the city. Although sizes may vary depending on your selection of bedrooms, Beijing apartment is start from 28m² and could go up to 38m².

If you don't need an entire apartment, then you could choose to rent a room in Beijing. This is a more Affordable way to rent in the city and also provides you with a social network in a new and unfamiliar city. Rooms in Beijing are available from less than 1,000 Chinese Yuan, or around €120 per month, but will vary greatly. More luxurious rooms and affluent neighborhoods will obviously cost more, but you can rent a room in Beijing for between 1,000 and 2,000 Yuan on average. Beijing hotel rooms can also be found at affordable rates. You might want to stay in a hotel if you're on a short-term visit for work.

4.4.4 Homelessness rate

Many ambitious homeless people in Beijing: They came to big city themselves in the hope of improving their family situation but failed. This has caused massive rural-to-urban migration where people travel to larger cities to find work. However most of them were not well-educated and some even disabled or elderly, so it was difficult for them to keep pace with development and they just lost their jobs. Most of the homeless lost their ID card so they couldn't find another job.

There are the slums. These slums are located in the downtown area of Beijing. Although the slums are dirty, and not an ideal place to live in, the government says that it is a solution for poor people to live in. That the slums are the solution for homeless people. That it least if they put aside room for slums in Beijing than people would have some shelter. However is a place where people can afford to live in.

In Beijing they have made a solution for the slums, they have started to build shelters for homeless The four shelters are build in Beijing ,the located in Chaoyang, Haidian, Fengtai and Shijingshan districts of Beijing's city proper. The shelters will help homeless people who

cannot afford food or housing, without relatives to help them, and who do not qualify for allowances for urban or rural residents. Homeless people will be able to stay at the shelters for no more than 10 days, according to the civil affairs bureau of Beijing. Those who have made a career of begging, and show no inclination of taking up regular employment, will not be helped, said the bureau.

Photos of slums in Beijing

4.5 Architecture and Urban design

4.5.1 Styles of architecture

Beijing has a range of architectural styles, but the three most prevalent are the traditional imperial style (the Forbidden City), the "Sino-Sov" style (boxy structures built between the 1950s and 70s), and lastly the explosion of a modern corporate style that is punctuated with Starchitect buildings like OMA's CCTV TV Station HQ.

CCTV Headquarters

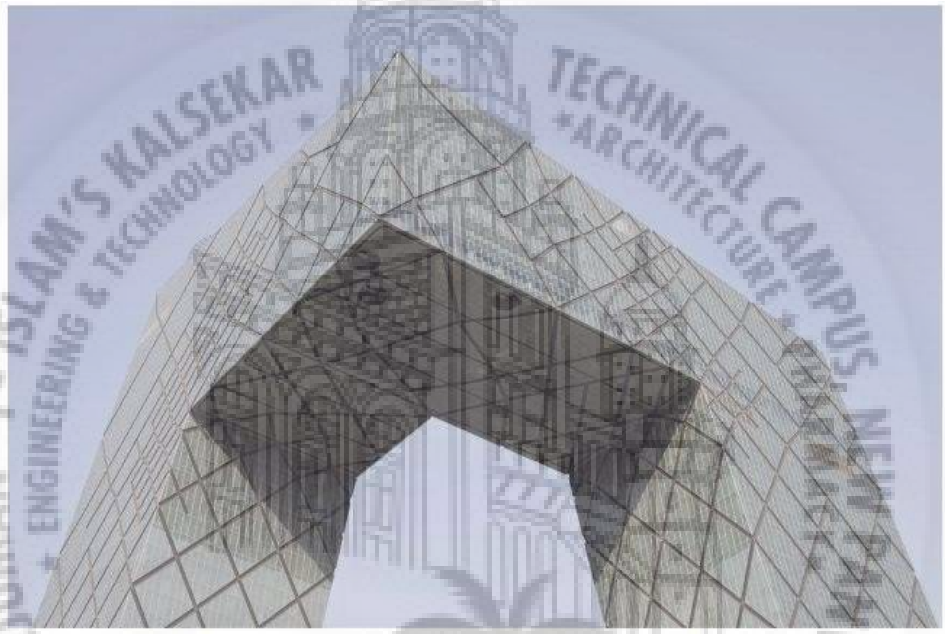
The building that most epitomizes modern Beijing architecture is arguably the CCTV Headquarters building — a twisty, robotic structure that some have called a masterpiece of pure genius.

Designed by the Pritzker Prize-winning Dutch architect Rem Koolhaas, the totally unique CCTV

building is one of the largest office buildings in the world. Only the Pentagon has more office space. The angular 49-story towers appear about to topple, yet the structure is carefully designed to withstand earthquakes and high winds.

Jagged cross-sections made with some 10,000 tons of steel form the sloping towers.

Home to China's only broadcaster, China Central Television, the CCTV building has studios, production facilities, theaters, and offices. The CCTV building was one of several bold designs constructed for the Beijing Olympics in 2008.



CCTV Headquarters iDesigned by Rem Koolhaas. James Leynse/Corbis via Getty Images

National Centre for the Performing Arts

The titanium and glass National Centre for the Performing Arts in Beijing is informally called The Egg. In every beautiful image of the exterior, the architecture seems to rise like a being or bob like an ovum in the surrounding waters.

Constructed between 2001 and 2007, the National Grand Theater is an oval dome surrounded by a man-made lake. Designed by French architect Paul Andreu, the stunning building is 212 meters long, 144 meters wide, and 46 meters high. A hallway beneath the lake leads into the building. It is located just west of Tiananmen Square and the Great Hall of the People.

The performing arts building is one of several bold designs constructed for the 2008 Beijing Olympics. Interestingly, while this modern building was being constructed in China, a futuristic, elliptical tube that architect Andreu designed for the Charles de Gaulle airport collapsed, killing

several people.

National Centre for the Performing Arts, The Egg, Beijing, China. Tom Bonaventure/Getty Images (2x)

4.5.2 Historical Development

In earlier times, homes were built based on the inherited knowledge of the indigenous population using local building materials such as palm leaves, stones and mud. Residential buildings were low-rise, spacious courtyard houses. The design followed the Chinese courtyard tradition of dividing male and female spaces, which was further visible in the alleys within neighborhoods Beijing urban planning with economic development and political instability can be divided into four rounds since 1949.

first round (1949 - 1978)

Traditional city was planned as productive city and was no longer a consumer city. Urban Planning learned from the Soviet urban planning model, Planed a city of the planned economy, construction and engineering organizations. It always prepared to implement the national economic plan to regulate the production and living. Main planning the content included overall spatial layout and some special planning such as external transportation planning, urban road planning, electric power and telecommunications planning, water supply and drainage plan, landscaping plan, and public facilities as well as a short-term construction planning. The master

planning focused on: (1) medium and large industrial construction projects in a reasonable location in the city;(2) urban functional areas; and (3) urban transport and infrastructure. The master plan played an important role of the urban production and living.

second round (1978 - 80 late)

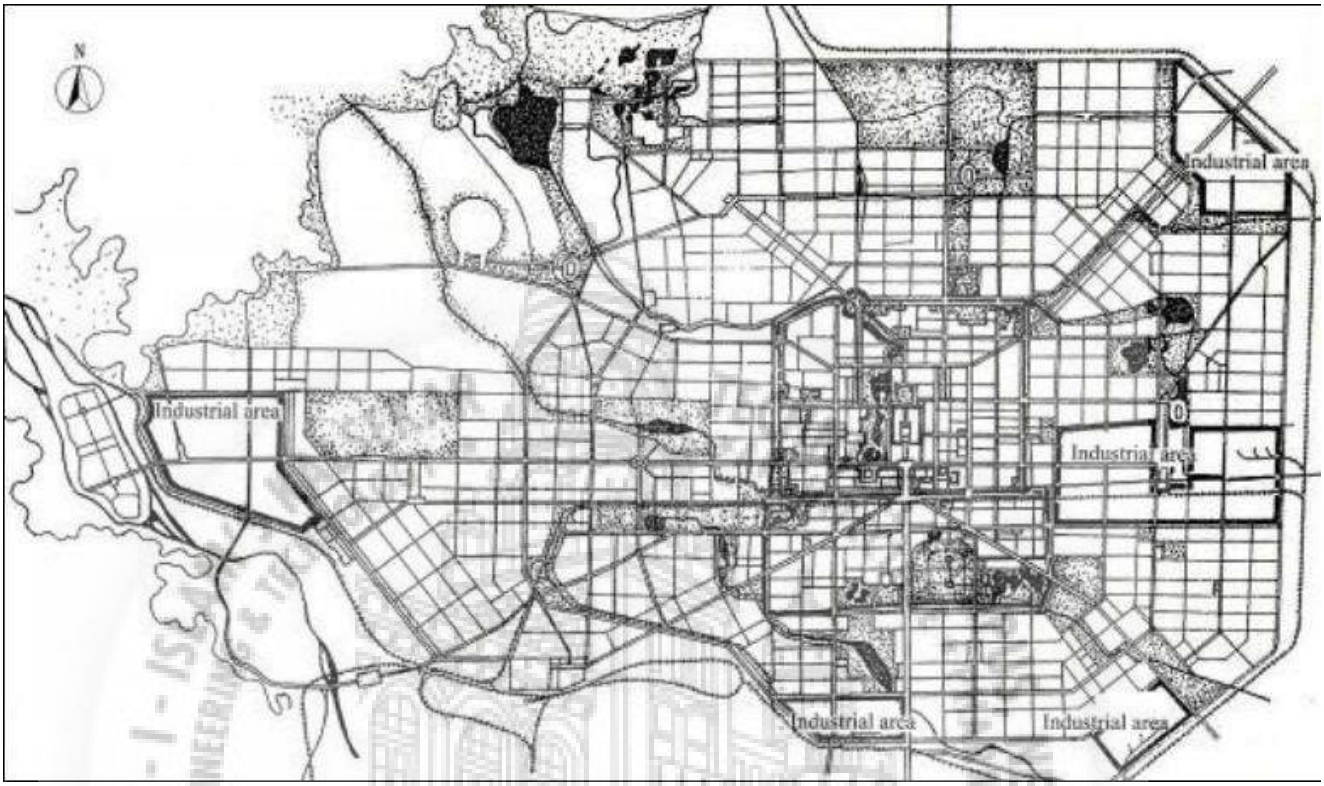
In this stage, some main planning content were added in the overall spatial layout such as economic and social analysis of urban development, as well as urban system planning. The special plans enriched some content such as the implementation plan and zoning. The master planning focused on: (1) urban nature, size, direction of urban development and spatial structure, a reasonable urban functional areas (2)urban system planning (3)urban infrastructure planning (4)urban environmental protection plan and (5) transformation of the old downtown area. The master plan played a role of the development of the regional urban system and urban infrastructure for the modernization of the urban building. It still laid a basic framework of urban development.

third round (late 1980s – 2000)

In this stage, the master plan played a very important role for urban economic growth and social development The master planning focused on the socio-economic development and environmental issue according to the principles of sustainable development, and Pushed forward process of China's urbanization. Some new planning content were added such as the outline, utilization of underground space, urban comprehensive transportation planning, and some cities also prepared a urban image and features planning, tourism planning, etc. The master planning focused on: (1) goals of modernization of Chinese urban development (2) historical and cultural protection and development in urban areas

Fourth round (since 2000)

The master planning increased its global vision of urban development, and emphasized the development of global cities, and cities have also begun to focus on the development of producer services. The master planning focused on: (1) economic globalization on urban and regional development; (2) large-scale infrastructure; (3)global economic networks; (4)development of tertiary industry

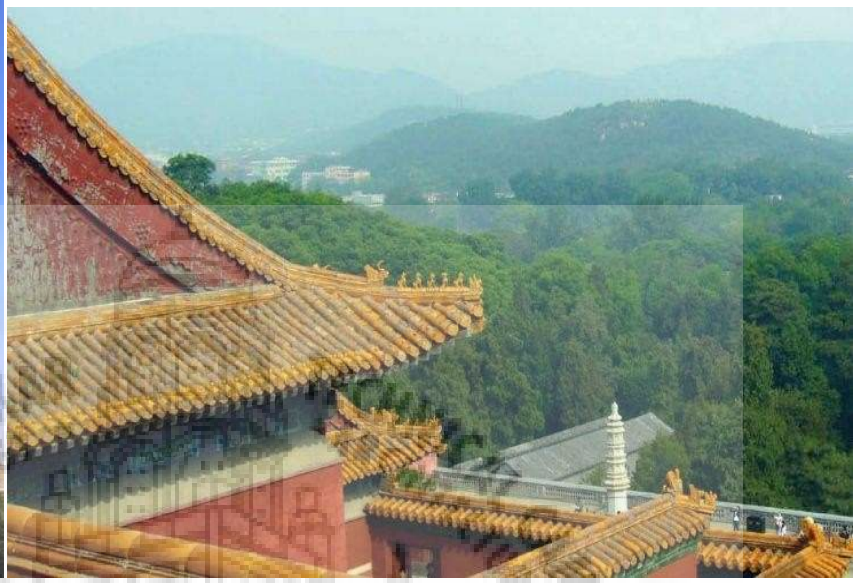


Beijing Plan in 1953 (Hua's Proposal)

4.5.3 Features of Traditional architecture

China has a unique and time-honored architectural tradition, dating back to the Zhou era 2,500 years ago. Discover the reasons behind its features and how China's architecture reflects Chinese culture. Since ancient times, several types of architecture have been traditionally built by the Chinese.

Heavy Overhanging Roofs



A noticeable feature of the traditional wooden buildings is the heavy ceramic tiled roofs with wide eaves and slightly upturned corners. The builders considered it important to cover wooden buildings with overhanging roofs. This was to protect the building from weathering since wood rots much faster when it is wet. The wide eaves also provided shade in the summer, and in the winter, the slanted sunlight warmed the buildings.

As you can see in the picture of a building in the Forbidden City, in traditional buildings, the eaves were not supported by columns past the walls. The eaves might overhang the walls by several meters. Since ancient times, durable ceramic tiles were the favorite roofing material, but they were heavy.

South Facing Orientation

This long narrow courtyard that was oriented north/south allowed the sunlight to warm the main building with the big doorway. 101

The south facing orientation had a practical reason. When courtyards were built with taller buildings in the north north and in the south shorter walls facing east and the west, it allowed the maximum amount of sunlight to warm the building during the winter months when the sunlight was angled strongly from the south.

Enclosure

In much of traditional Chinese architecture, buildings or building complexes take up an entire property but enclose open spaces within themselves. These enclosed spaces come in two forms, the courtyard and sky fall.

A skywell in a Fujian temple with enclosing halls and bays on four sides.

These enclosures serve in temperature regulation and inventing the building complexes. Northern courtyards are typically open and facing the south to allow the maximum exposure of the building windows and walls to the sun while keeping the cold northern winds out. Southern sky wells are relatively small and serve to collect rain water from the roof tops. They perform the same duties as the Roman impluvium while restricting the amount of sunlight that enters the building. Sky wells also serve as vents for rising hot air, which draws cool air from the lower stories of the house and allows for exchange of cool air with the outside.

Architectural bilateral symmetry

A very important feature in Chinese architecture is its emphasis on articulation and bilateral symmetry, which signifies balance. Bilateral symmetry and the articulation of buildings are found everywhere in Chinese architecture, from palace complexes to humble farmhouses. When

possible, plans for renovation and extension of a house will often try to maintain this symmetry provided that there is enough capital to do so.[10] Secondary elements are positioned either side of main structures as two wings to maintain overall bilateral symmetry. The buildings are typically planned to contain an even number of columns in a structure to produce an odd number of bays. With the inclusion of a main door to a building in the center bay, symmetry is maintained.

4.6 Sanitation facilities

4.6.1 Water Supply

Beijing, the capital of China, is characterized by intense water scarcity during the long dry season as well as l flooding during the brief wet season. Beijing is one of the most water scarce cities in the world. Total water use is 3.6 billion cubic meters, compared to renewable fresh water resources of about 3 billion cubic meters.

The difference is made up by the overexploitation of groundwater. Two-thirds of the water supply comes from groundwater, one third from surface water. Average rainfall has substantially declined since the1950s.

Furthermore, one of the two main rivers supplying the city, the Yongding River, had to be abandoned as a source of drinking water because of pollution. Water savings in industry and agriculture have compensated for these losses and freed up water for residential uses.

The water sources in Beijing come from the surface water (stored in Miyun Reservoir, etc. ground water and diverted water through such projects like the middle line of South-North Water Transfer Project (SNWT).

The water supply in Beijing is achieved mainly through self-reliant wells and rural collective waterworks. The public utility is operating 68 waterworks with daily capacities of 5 million m3, supplying water for downtown and newly-built urban areas. There are about 50,000 water supply wells, extracting about 1.4 billion m3 of groundwater a year. A program was initiated from 2014 to replace those self-reliant wells with the water transferred from the Yangtze River.

4.6.2 Sewage Management

Up to 2014, Beijing had 50 medium and large-sized waste water treatment plants (their daily capacity is 10,000 tons at least) with the total capacity of 4.25 million tons/day, which totaled 1.39 billion m3 of sewage treated water in 2014. That means 86.1% of sewage water was treated, and the figure for downtown was 97%. In 2014, 860 million m3 of reclaimed water was used.

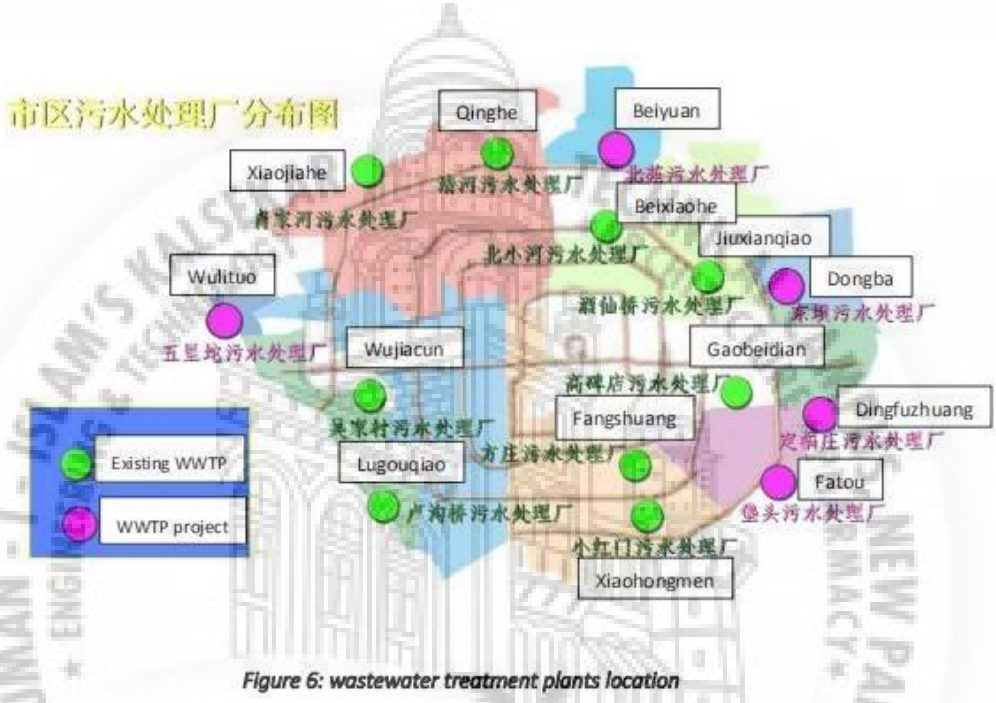


Figure 6: wastewater treatment plants location

4.6.3 Solid Waste Management

In Beijing, there is a dual waste management system whereby rubbish is collected either by the municipality or by informal waste pickers. These two systems diverge with regards to recycling: indeed, even though recycling bins were introduced in the city in 2008, people do not actually sort their waste. Urban dwellers do not separate because the waste did not remain sorted in the collection process (inhabitants saw the different bins being emptied in the same truck) at the time, probably due to the lack of infrastructure to implement it. The municipality is thus faced with a prisoner's dilemma: should it enforce a separate collection despite the absence of source sorting? Would educating the public suffice? Or is there an issue of lack trust preventing successful implementation? The state's incapability in implementing source sorting makes waste pickers the major actors in this field: it is estimated that 200,000 informal collectors collect and recycle 30% of Beijing's waste.

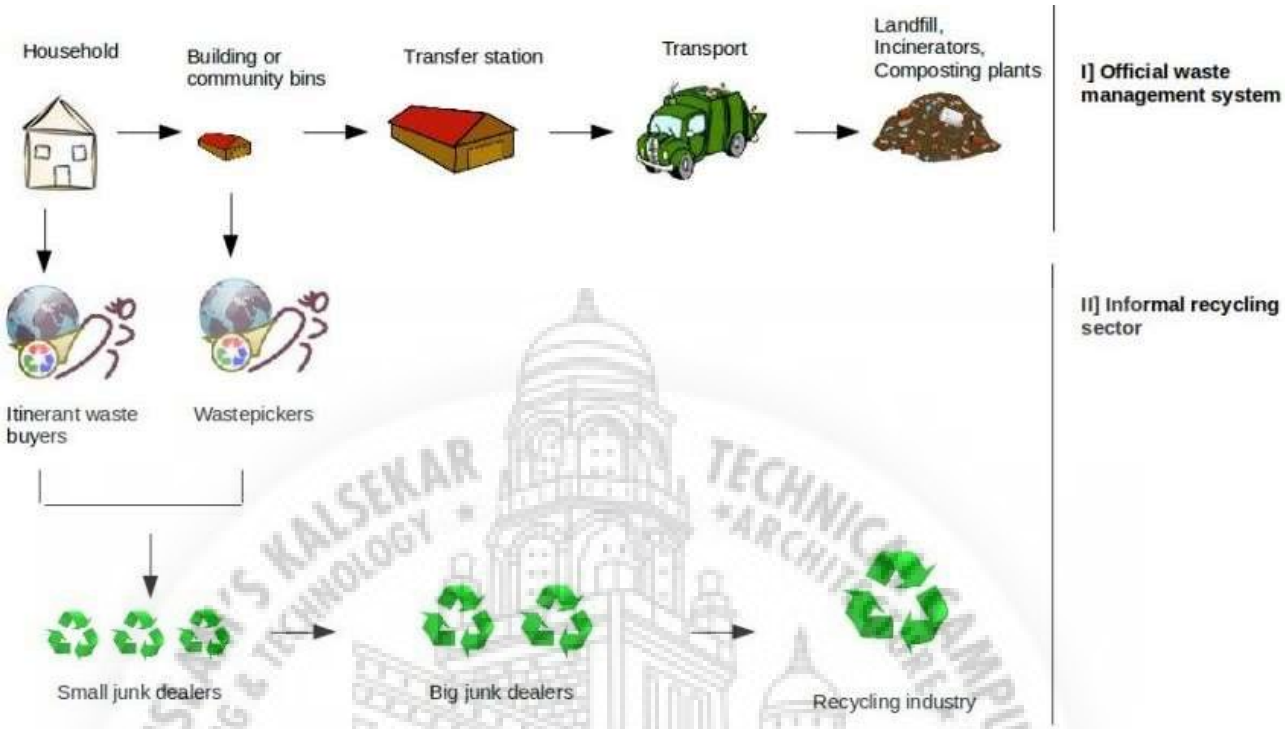


Figure 1. Waste Management in Beijing diagram according to the Global Alliance of Waste Pickers

The informal sector works differently and generates its income with recycling. An underprivileged population is generally in charge of waste picking: this process includes going door to door, rummaging through garbage cans, etc. They then sell it to the picker; while the "waste collector" works with bicycles, small vehicles or on foot, the picker tends to use a truck. Pickers are specialized in certain types of waste: plastic, glass, paper, etc. They then sell their merchandise to buyers, so either to an informal landfill or through large recycling markets.

4.7 Environment and Sustainability

4.7.1 Climate Change

Though Beijing is a relatively short distance from the sea, the general air circulation in the region is mainly from the northwest throughout the year; maritime effects on the region's weather are meagre. The climate is clearly of the continental monsoon type that occurs in the temperate zone. Local topography also has a great effect on

Beijing's climate. Because it lies in lowland area and is protected by mountains, the city is a little warmer in winter than other areas of China located at the same latitude; nonetheless, the mean monthly temperature drops below 50 °F (10 °C) for five months out of the year. In addition, wind

direction in Beijing is influenced by topography, with changes occurring from day to night. Generally, there are more southerly winds in the day but northerly or northwesterly winds at night.

The annual mean temperature of the city is 53 °F (12 °C). The coldest month is January, when the monthly mean is 24 °F (–4 °C), and the warmest month July, when it is 79 °F (26 °C). In an average year, the city experiences 132 days of freezing temperatures between October and March; the mean annual precipitation is 25 inches (635 mm), with most of the total falling from June to August. July is ordinarily the wettest month of the year, with an average of 9 inches (230 mm)

4.7.2 Green Buildings

China is making rapid progress in green buildings and appears set to cement its place among the world's top markets for cost-effective and environment-friendly structures, according to an industry report.

The 2017 China Green Building Report by CBRE Research said the green building concept has been accepted by more and more property developers and local governments in China. This has already made China the world's second-largest market for LEED-certified projects, trailing only the United States. LEED stands for Leadership in Energy and Environmental Design, the world's most widely used green building rating system.

Latest data suggest there are over 520 million square meters of green building space in 336 Chinese cities. Including LEED-certified projects, accredited green building space would total over 600 million sq m.

LEED aims to help building owners and operators be environmentally responsible and use resources efficiently. It includes a set of rating systems for the design, construction, operation, and maintenance of green buildings, homes and neighborhoods.

As of August 2017, LEED-certified space in Beijing, to date 54 cities are covered by LEED's footprint in China. Beijing is the first Chinese city to have more than 10 million sq m of LEED-certified green building space.

Beijing counts number of remarkable green building, Green building does not always mean high-tech and expensive.

Wangjing Soho

Date of completion: 2014

Architects: Zaha Hadid

Usage: Office building and commercial buildings (as well as sports area, recreational theatre, art sculptures and waterscape).

Key facts:

U.S. Green Building LEED Certified

Surface: 115,392 sqm (floor)

Height: 200 m (3 towers)

Energy efficient

Window wall system with double-insulated

China's First Green Office Building

Date of completion: 2005

Architect: Gao Lin Usage: Office building Key facts:

Gold rated High LEED (Leadership in Energy and Environmental Design) Surface: 13,000 m2

Height: 34.2 m (8 story about ground level) Built at no additional costs

74% overall energy reduction compared with other typical office buildings

(Thanks to an energy-efficient cooling system to a roof garden, solar PV panels and a solar hot water system)

64% water savings compared with other typical office buildings.

Address: 8 Yuyuantan Nanlu, Haidian district.

4.7.3 Energy Efficiency

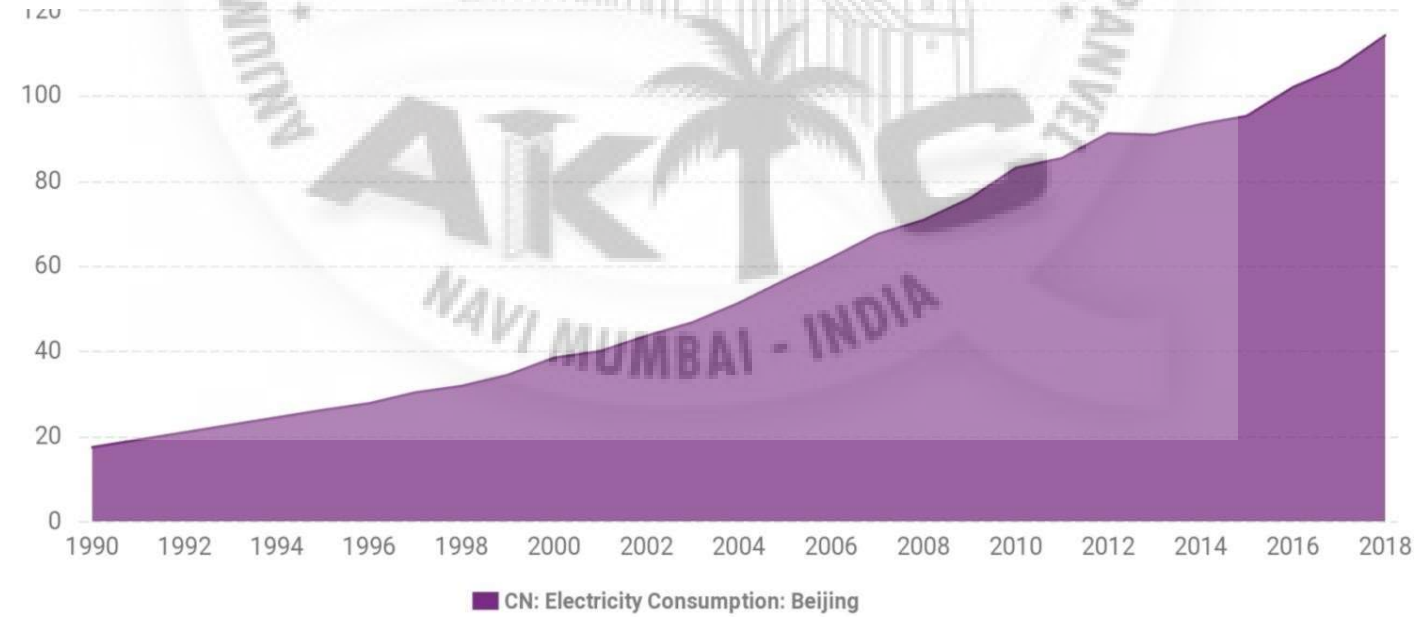
China is also the world largest renewable energy producer. China is largest producer of hydroelectricity, solar power and wind power in the world.

China's CN: Electricity Consumption: Beijing data was reported at 116.640 kWh bn in 2019. This records an increase from the previous number of 114.238 kWh bn for 2018. China's CN: Electricity Consumption: Beijing data is updated yearly, averaging 64.704 kWh bn from Dec 1990 to 2019, with 26 observations. The data reached an all-time high of 116.640 kWh bn in 2019 and a record low of 17.413 kWh bn in 1990. China's CN:

ectricity Consumption: Beijing data remains active status in CEIC and is reported by China Electricity Council. The data is categorized under China Premium Database's Utility Sector – Table CN.RCB:

Electricity consumption.

Last	Frequency	Range
116.640 2019	Yearly	1990 - 1990



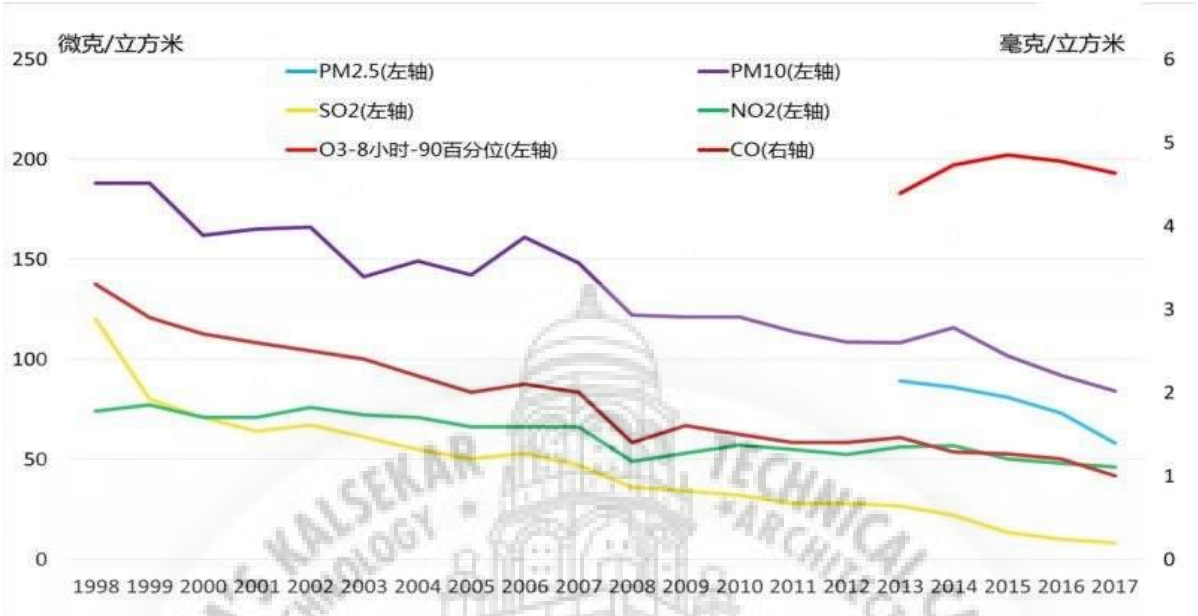
4.7.4 Pollution

In 1998 Beijing declared war on air pollution. The challenge was to find ways to improve air quality in one of the largest and fastest growing cities in the developing world. 20 years on and it appears that Beijing is winning the battle. Air quality has improved substantially, and the lessons learned provide a roadmap for other cities tackling air pollution.

A new report by the United Nations Environment Programme (UN Environment) and the Beijing Municipal Ecology and Environment Bureau (BEE) outlines how Beijing's air quality management programmer has evolved over the past quarter century and makes recommendations for near, medium, and long-term steps that Beijing can take to maintain its momentum toward clean air.

The report, A Review of 20 years' Air Pollution Control in Beijing, was compiled by a UN Environment-led team of international and Chinese experts over two years. It covers 1998 to the end of 2017.

This improvement in air quality didn't happen by accident. It was the result of an enormous investment of time, resources and political. In 1998, air pollution in Beijing was dominated by coal combustion and motor vehicles. Major pollutants exceeded national limits. Over the next 15 years Beijing implemented a series of measures focused on energy infrastructure optimization, coal-fired pollution control, and vehicle emission controls. By 2013 levels of air pollutants had fallen (see graph below) and some pollutants, like carbon monoxide and sulfur dioxides, met national standards.



4.8 Conclusion and Lessons Learnt

- Beijing is now facing is how to allocate arable land, built-up Area and conservation land. In urban areas, urban population density is very high and urban problems are serious. These will greatly spur urban land expansion.
- Beijing is leading energy intensity reduction efforts in China, but it does not yet have specific Climate actions and policies.
- The city was built at the mouth of this embayment, which opens onto the great plain to the south and east, and between two rivers.
- In Beijing Series of innovative planning measures were introduced, including The Green Belt, New Towns and well-regulated development controls.
- Beijing are most representative cities in China in terms of their political, economic and cultural influences so it is indicating a peak in car use has happened. This coincides with major investments in public transport that have provided an option surpassing many car use patterns. This has happened despite increasing economic growth and car ownership growth.
- Green space in Beijing was higher in the west and lower in the middle and east. The high-value area of the green space area is correspondence with scenic spots and historical sites, parks and green spaces, and buildings that were constructed in different ages.
- The city of Beijing is a somewhat unique case because its concentration of governmental institutions embeds administrative forces more deeply in the market transition. Being the

political capital, housing reform here undoubtedly has been implemented more cautiously and slowly.

- Beijing is facing severe water shortages due to rapid urburbanization.
- Beijing has made intensive efforts to promote a reasonable utilization of existing water supplies, to conserve water, to reclaim wastewater, and to import water from surrounding areas.
- Beijing falls within global trends of waste management that can be observed throughout the world in so-called Developing cities.
- Urban air pollution is closely associated with the level of economic development. China is in a period of rapid development, and urban air pollution has already become an important environmental problem. Now Chinese cities face two major sources of pollution: coal smoke and vehicle emissions. The deteriorating air quality in urban areas hurts public health and the environment.

CHAPTER 5: ANALYSIS OF LONDON CITY

5.1 Introduction

Geography, History, Population

London is the largest urban area and capital city of the United Kingdom. It is located in the southeast of Great Britain. The London region covers an area of 1,579 square kilometers (610 sq. mi).

The city of London was founded by the Romans and their rule extended from 43 AD to the fifth century AD, when the Empire fell. During the third century, Londinium, the name given to the town by the Romans, had a population of 50,000, mainly due to the influence of its major port.

London's 2020 population is now estimated at 9,304,016. In 1950, the population of London was 8,360,847. London has grown by 642,635 since 2015, which represents a 1.44% annual change.

Name of the city: **LONDON**
Country, Continent: **ENGLAND, EUROPE**
Area: **1,572 km²**
Population: **9.06 million** (July 2020)
Population density: **5,590/m2**
First settle: **1000–1100 B.C.E** (founded by Brutus of Troy)
Declared capital: **100 A.D**
Planned/Unplanned: **Planned city**
Government of Country: **Constitutional monarchy**
Elevation above MSL: **25m / 82ft**
HDI (HDI rank of country): **0.967 (1st rank in 2018)**
Nominal GDP per capita of country: **650 billion dollar (2018)**
Language: **British English**

5.2 Land Use

5.2.1 Land Use Classification

As per statista.com, land use of London in 2015, 36 percent of all London's land was used for residential real estate and new residential construction. Further 25 percent of the land was "green", which included sport fields, parks, agricultural land, but excluded residential gardens. Employment-specific real estate occupied 11 percent of the land: nine percent for retail, public services and warehousing, one percent for office spaces and further one percent for industrial undertakings, excluding warehouses.

5.2.2 Governance and Municipality, Zoning Laws

London's government operates within a relatively centralized, unitary state. Since 2000, 8.6 million residents of London have been governed by a directly elected mayor and the Greater London Authority. The mayor sets the strategic framework for all of London's 33 boroughs and has executive powers over a number of citywide areas.

The 25 directly elected members of the London Assembly have the responsibility of scrutinising the Mayor's Office.

Zoning laws define how property in specific geographic zones can be used. Zoning ordinances detail whether specific geographic zones are acceptable for residential, commercial or industrial purposes.

Commercial aspects of London, London is the most populous region, urban zones and metropolitan area in the United Kingdom, London had the fifth largest metropolitan economy in the world in 2011 according to the Brookings_institutions some of its neighborhood shave estimated per capita GVA as high as £116,800 ($162,200). The London fiscal surplus, £32.5 billion in 2016–17 mostly goes towards funding services in other parts of the UK. London has five major business districts: the City, Westminster, Canary Wharf, Camden & Islington and Lambeth & southwark.

One way to get an idea of their relative importance is to look at relative amounts of office space: Greater London had 26,721,000 m^2 of office space in 2001.

London is home to over 800,000 small and medium sized enterprises (SMEs) that account for 99.8% of London's businesses and nearly half of the capital's jobs. Together they generate approximately £430 billion of turnover, as well as hold the potential for much of London's future innovation and growth. Industrial areas accommodate a wide range of economic sectors. Many of these serve the London market, including food preparation, printing, construction, distribution, waste and recycling, and other utilities which need to be close to their markets for sustainable and efficient operation.

According to statista.com, the residential property and area in 2001-2018 has a stock of approximately 3.56 million dwellings. By 2041, the estimated population of London will grow to 10.35 million individuals, all searching for a place to live.

5.2.3 Open and Green spaces

The access to green spaces and recreational area has shown an association with recreational walking, increased physical activity, and reduced sedentary time in all ages.

With 3,000 parks of varying sizes designated by the boroughs as 'public open space', London is a green city. Together they cover almost 18 per cent of London which is more than the area of the city covered by railways and roads combined. Parks, gardens and recreational area spread in 9294 ha and it occupies about 5.83% of total land use of open space in greater city of London. Other land use includes, Natural and Semi-Natural Urban Greenspace and green corridors covers about 14668 ha that is 9.2% of total free space.

5.2.4 Cultural Places

The culture of London concerns the music, museums, festivals and lifestyle within London, the capital city of the United Kingdom. The city is particularly renowned for its theatre quarter, and its West End, theatre district has given the name to "West End theatre", the strand of mainstream

professional theatre staged in the large theatres in London. London is also home to notable cultural attractions such as the British Museum the Tate Galleries, the National Gallery the Notting Hill Carnival and The O2. Through music, comedy and theatre, London has a lively nightlife with approximately 25.6 events per thousand people, 44.1% of those events being theatre based. A variety of landmarks and objects are cultural icons associated with London, such as Big Ben, Buckingham palace and the tube map. Many other British cultural icons are strongly associated with London in the minds of visiting tourists, including the red telephone box, the AEC bus, the black taxi and the Union Flag. The city is home to many nationalities and the diversity of cultures have shaped the city's culture over time

5.2.5 Industrial Development

The economy of London is dominated by service industries, particularly financial services and associated professional services, which have strong links with the economy in other parts of the United Kingdom (UK) and internationally. In addition to being the capital city of the United Kingdom, London is one of the world's leading financial centers for international business and commerce and is one of the "command centers" for the global economy.

Picture: Automobile industries and Gas station and petroleum companies.

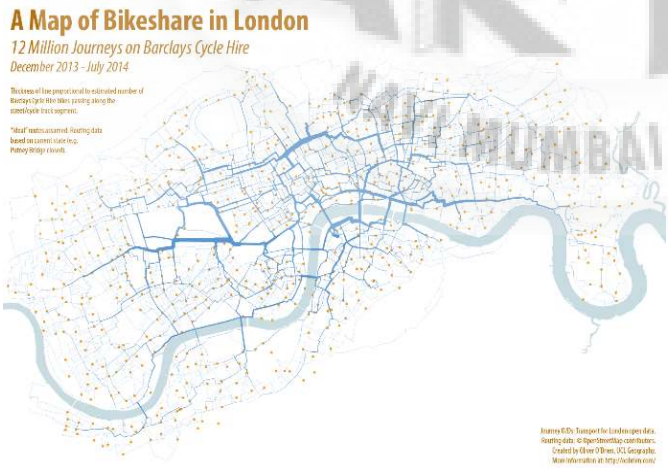
5.3 Transportation Infrastructure

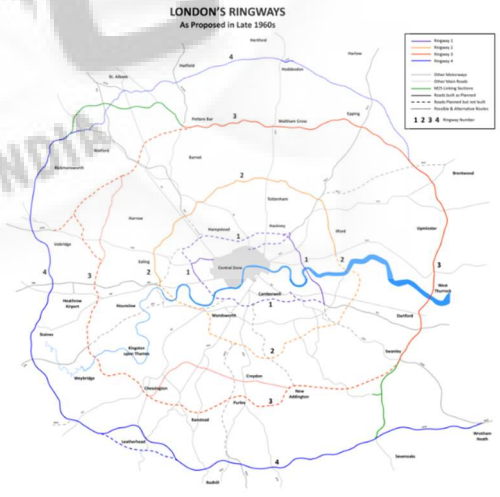
London has been significantly congested since the 17th century. Various select committees were established in the late 1830s and early 1840s in order establish means of improving communication and transport in the city. The Royal Commission on London Traffic (1903–05), produced eight volumes of reports on roads, railways and tramways in the London area, including a suggestion for "constructing a circular road about 75 miles in length at a radius of 12 miles from St Paul's".

5.3.1 Road System

The London Ringways were a series of four ring roads planned to circle London at various distances from the city center. They were part of a comprehensive scheme developed by the Greater London Council (GLC) to alleviate traffic congestion on the city's road system by providing high speed motorway-standard roads within the capital linking a series of radial roads taking traffic into and out of the city.

The ringways were originated 1960 with Country of London plan in concerning about increasing the traffic and congestion in the city. The plans attracted increasing opposition towards the end of the decade over the demolition of properties and noise pollution the roads would cause. Following a series of protests, the scheme was cancelled in 1973, at which point only three sections had been built.





5.3.2 Travel time and Congestion

Travel time reduce due to the number of public transport facilities. Tramlink, Metro rail, underground rail and river buses are means public transport facilities. Underground are major contribution for reducing of congestion and that of travel time. Congestion charge applied by the government of London. The London congestion charge is a fee charged on most motor vehicles operating within the Congestion Charge Zone (CCZ) in Central London between 07:00 and 18:00 Mondays to Fridays. It is not charged on weekends, public holidays or between Christmas Day and New Year's Day.

5.3.3 Public Transport System

Road and River Buses

For road travelling, London's famous and iconic **Double-decker buses** are a convenient and cheap way to travel around the city, with plenty of sightseeing opportunities along the way. London buses are **card only**, so no need for cash. Choose a Visitor Oyster Card, an Oyster card, a Travel card or a contactless payment card to pay your fare. A single London bus journey costs £1.50 no matter how far you go (unlike the Tube zone fare system). You can even take multiple buses within one hour at no extra charge thanks to the Hopper fare system. Plus, no matter how many buses or trams you take, it will never cost you more than £4.50 a day. For contactless payment cards issued outside the UK, it's best to check with your card issuer as transaction fees or bank charges may apply.

Travelling through river by **River bus** is a great way to get around London. You'll beat the traffic and enjoy fantastic views of London along the way. Thames Clippers operate frequent river bus routes. Oyster cards and Visitor Oyster cards are accepted on Thames Clippers services. Fares vary according to river zones and discounts; prices start from free for children under five, up to £19.90 for an adult River Roamer ticket. All London piers are accessible except for Cadogan Pier and London Bridge City Pier.

River bus and Oyster cards

Metro and light railways

Transport for London (TfL) operates three different railway systems across London. The largest is the London Underground, a rapid transit system operating on sub-surface lines and in deep-level "tube" lines. TfL also operates the Docklands Light Railway (DLR), an automated light rail system in the east of the city, and the Tramlink system.

Colloquially known as the Tube, the London Underground was the first rapid transit system in the world, having begun operations in 1863. More than 3 million passengers travel

on the Underground every day, amounting to over 1 billion passenger journeys per year for the first time in 2006.

The Docklands Light Railway (DLR) is an automated light rail system serving the Docklands area of east London. It complements the London Underground, largely sharing its fares system and having a number of interchanges with it. The DLR serves over 101 million passengers a year and is an essential piece of infrastructure to East London. The DLR's most heavily used stations are Bank, Canary Wharf, Canning Town, Lewisham and Woolwich Arsenal.

The Tramlink is a tram and light rail system serving Croydon and surrounding areas. It operates in the boroughs of Bromley, Croydon and Merton and has 39 stations. In 2011, it carried over 28 million passengers, up from 18 million in 2001

Picture: Tramlink, Docklands Light Railway and London underground.

5.3.4 Cycling Infrastructure and Walkability

Walking in London city is one of the way of transportation to nearby area. As walking path, cycling path and most of the skywalks are major mode of people transportation in city of London.

5.4 Housing

Population

Greater London is the most urbanized area in the United Kingdom and the most populous city in the European Union. Some one-seventh of the country's population is concentrated there, comparable in national significance to the urban agglomerations around Paris, Mexico City, and Tokyo. London's overall population density is considerably higher than those in the country's other urban areas. Greater London encompasses a total area of 1,583 square kilometers (611 sq. mi), an area which had a population of 7,172,036 in 2001 and a population density of 4,542 inhabitants per square kilometer (11,760/sq. mi). The extended area known as the London Metropolitan Region or the London Metropolitan Agglomeration, comprises a total area of 8,382 square kilometers (3,236 sq. mi) has a population of 13,709,000 and a population density of 1,510 inhabitants per square kilometer (3,900/sq. mi).

The 19 boroughs of Outer London have an average density that is only two-fifths that of the 14 inner boroughs. Yet even in Inner London the pattern of the streets and the style of the housing lacks the intense urban density of the great cities of mainland Europe. Only one residence in three was meant to be an apartment house.

5.4.1 Types of Homes

As a London developed commercially and residentially, London has 11 different types of housing systems depending upon people's preference which are as follows:

1. Flats
2. 2-level flats
3. Studio flats
4. Converted flats
5. Detached house
6. Semi-detached house
7. Terraced houses
8. End of terrace house
9. Cottages
10. Bungalows
11. Mansions

Common man of London are mostly prefer flats, 2 level flats, studio flats as per their needs including works and family. Millionaires of London city lives luxurious life as they live Bungalow and Mansion

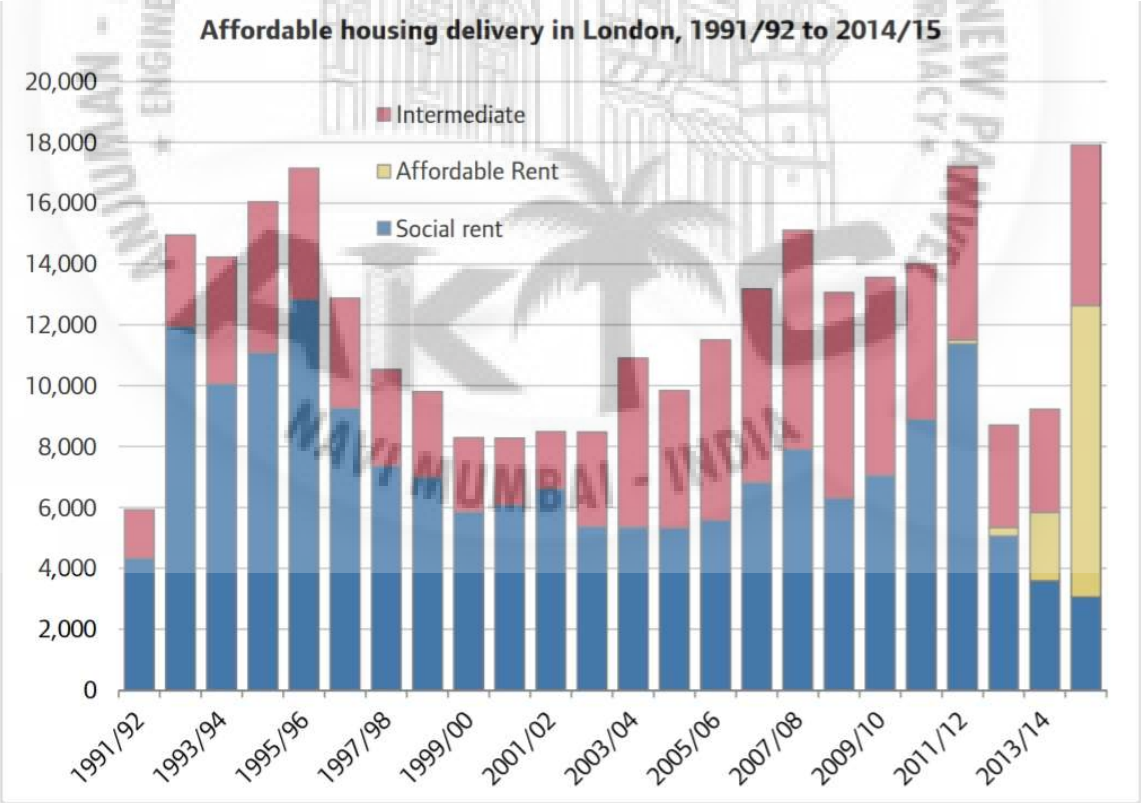
.

5.4.2 Affordability in Sale and Rent Prices

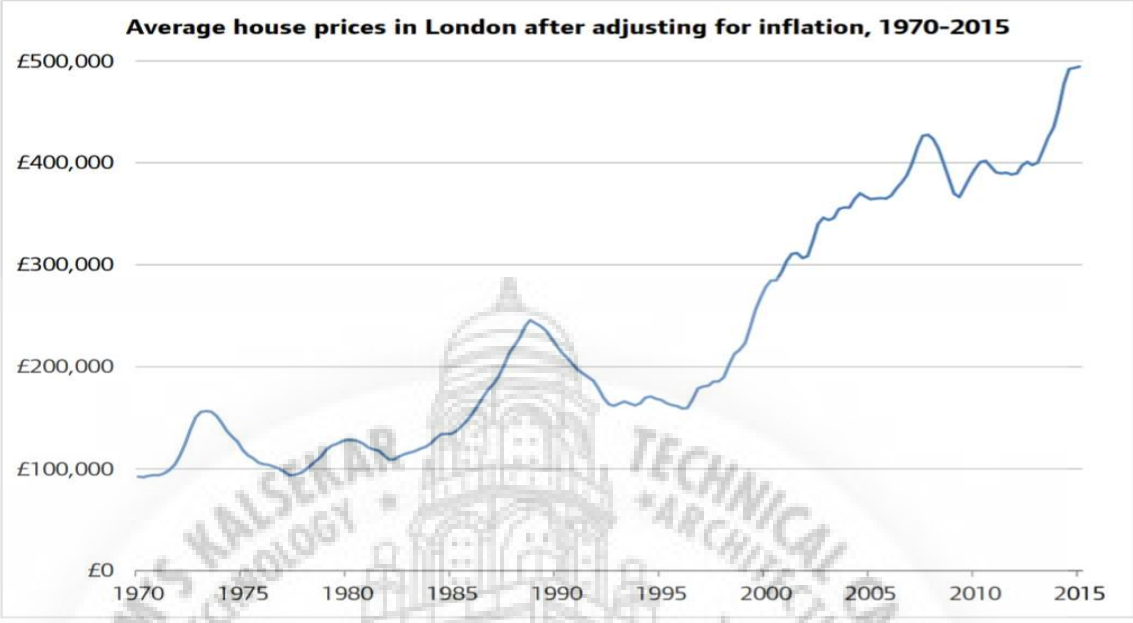
As per the survey of government of London, in 2015, London's average house price was £495,000 in early 2014, more than five times its level in 1970 even after adjusting for inflation. The gaps between average prices in London, its outer metropolitan area and the wider South East have widened considerably in recent years, but prices are now growing faster in other regions for the first time in several years. Average house prices are highest in West Inner London, and this

area also saw the greatest increase in prices over the last decade. Disparities in house prices within London have also widened at borough level over the last decade, with prices rising fastest in the most expensive boroughs. The distribution of prices for new and second hand homes diverged in 2015, with more new build homes priced between £350,000 and £500,000.

The affordability of owner occupation is at its worst ever level in London, while in the UK as a whole houses are still a little more affordable than they were before the recession. The typical first time buyer in London is now borrowing nearly four times their income, and high loan to income ratios have become particularly common in the capital. There were almost 50,000 new loans to first time buyers in London in 2014/15, down slightly on the year before. While the typical first time buyer in London puts down a deposit of 25%, mortgage payments are relatively low for those who are able to buy. Mortgage repossessions have fallen in London due to low interest rates, but there has been rapid growth in the number of landlord repossessions. Rates of repossession are highest in relatively deprived boroughs.



Demographic chart: Housing delivery in London (source: Housing in London 2014)



Demographic of house price in London in 2014-2015

Average private rents have risen very quickly in real terms in the last year, due to a combination of high nominal growth and zero inflation, and rental affordability has worsened as earnings have failed to keep up. London has by far the highest average private sector rents in the country, and there is also huge variation in monthly market rents within London and, in the most expensive boroughs, between the top and bottom of the market.

5.4.3 Homelessness rate/ Slums

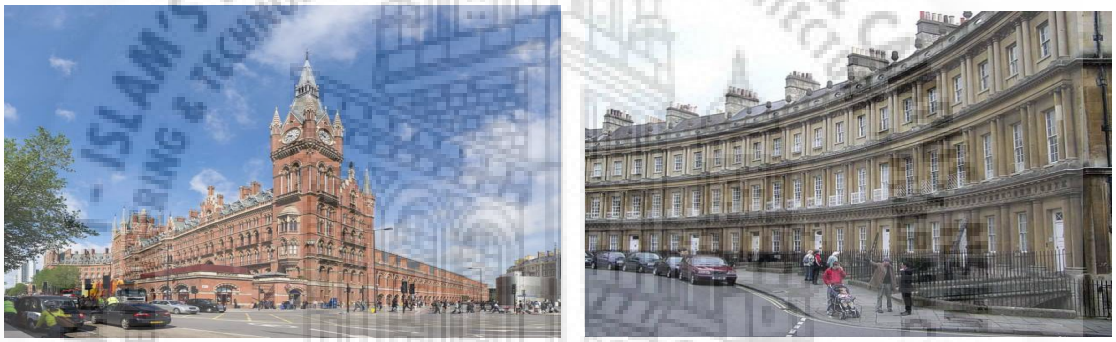
A person does not have to be roofless to qualify legally as being homeless. They may be in possession of accommodation which is not reasonably tenable for a person to occupy by virtue of its affordability, condition, location, if it is not available to all members of the household, or because an occupant is at risk of violence or threats of violence which are likely to be carried out.

According to 'The Guardian' news articles, the number of households considered newly homeless or at risk of becoming so has increased by 11.4% across England in 2018, according to government figures, a rise of almost 7,000 households. With increase in number of 7000 homeless people in London in 2018, the capital city becomes the highest number of homeless city of entire UK.

5.5 Architecture and Urban design

5.5.1 Styles of architecture

Many ages of architecture came in the city of London and all of them left their mark on the history of the city. From the Middle Age; Norman, Gothic and Tudor architecture (1066–1603) to Postmodernism, High-Tech and High-Rise Architecture includes Baroque London architecture, Georgian architecture, Regency architecture, Victorian architecture, Edwerdian architecture Art Deco and Interwar architecture, post War period architecture are the different ages of architecture in city of London. Architecture in London starts from the ages of Roman's named Roman London which has period of 50-600 CE.



Picture: Victorian architecture building and Georgian architecture building

Tower Bridge

The world famous Tower Bridge often namely known as London Bridge was built in the Neo-Gothic style. Also known as Revival Gothic, this architectural movement began in the mid-18th century and continued far into the 1930s. One of the earliest Neo-Gothic buildings in England is Strawberry Hill House, located near Twickenham, which was designed by Horace Walpole in the mid-1700s. Tower Bridge was one of the last buildings to have been constructed in the Neo-Gothic style in London (although, Minster Court, which can be seen from the West Walkway, was constructed over 100 years later opening in 1992).

5.5.2 Historical Development

England had no capital city. However, the institutions of central government were moved to Westminster, close to London. This and the rise of trade in the area were two decisive factors in London's emergence as the capital of England. During the fourteenth century, London's port became a European hub for the distribution of goods. This activity was strengthened during the fifteenth century thanks to its relevant textile industry. From the sixteenth to mid-seventeenth century, London benefited from the centralized politics and the maritime trade expansion developed by the Tudors and continued by the Stuarts. During Henry VIII's reign London had 100,000 inhabitants. In mid-seventeenth century it had over 500,000.

In 1665, the city was still held inside the ancient walls although large-scale urban planning had already started. The population's poor living conditions were responsible for the Great Plague, killing 70,000 people, and the following year, a huge fire burnt down most of the city. The reconstruction of London, based on the area we now call "The City", took over 10 years to finish. The architect Christopher Wren's masterpieces such as St. Paul's Cathedral increased the appeal of London, and thus the capital became the center of English social life with palaces, halls, theatres, societies and museums 1753

Ancient time of London

5.5.3 Features of Traditional architecture

The characteristics of traditional architecture used by architects and builders includes a **commitment to maintaining a link to the past styles of building, reuse of materials** or designing homes and building to stay consistent with the overall building design of the area.

5.6 Sanitation Facilities

5.6.1 Water Supply

London water supply system developed over the centuries from sixteenth century following seventeen, eighteen, nineteen, twenty upto present period i.e twenty first century. At present day Greater London is currently supplied by four companies: Thames Water (76% of population), Affinity Water (14%), Essex and Suffolk Water (6.6%) and Sutton and East Surrey Water (3.7%). Most of London's water comes from non-tidal parts of the Thames and Lea, with the remainder being abstracted from underground sources. The following operational reservoirs (in 2020) supply water to London. The water treatment of London's two primary water sources fall under the jurisdiction of two Boards: the Lake Huron Primary Water Supply System Joint Board of Management and the Elgin Area Primary Water Supply System Joint Board of Management. Water is delivered from Lake Huron to the Arva Pumping Station, where the City of London's water distribution system begins. Similarly, Lake Erie water is also delivered to the Elgin-Middlesex Pumping Station, from which the City of London assumes responsibility.

On an annual basis, the City of London performs over 12,000 water quality tests. London also has 10 locations throughout the city in which continuous online sampling of chlorine residual is monitored. All of these efforts help ensure that the water within the distribution system is always of high quality. In all, the drinking water in London is sampled for 112 different organic, inorganic, microbiological, and chemical parameters. All samples are collected by certified city personnel and submitted to an accredited laboratory for analysis in accordance with the Safe Drinking Water Act, 2002.

5.6.2 Sewage Management

The City of London operates five wastewater treatment plants and 38 pumping stations. The wastewater treatment plants are located along the Thames River.

The Wastewater Treatment Plants use:

1. Screens and settling tanks to remove solids.
2. Bacteria to consume organic material and convert ammonia to nitrates.
3. Chemicals to remove phosphorous.
4. Ultra-violet light to disinfect.

Some famous water treatment and sewage treatment plant are Beckton Sewage Treatment Works and Thame's wastewater treatment plant. Thame's water has over 43,500 miles of sewer, 2,530 pumping stations and 1.2 million manholes. They generate electricity from waste from more than 50 years and create largest source of renewable source of energy.

5.6.3 Solid Waste Management

Solid waste management plays major role in development of city in health and all aspects. The Environment Committee is investigating aspects of London's waste generation, handling and disposal, to inform the development of work under the Mayor's Environment Strategy and other policies. The three aspects for particular focus are:

• Waste reduction and the circular economy

• Recycling

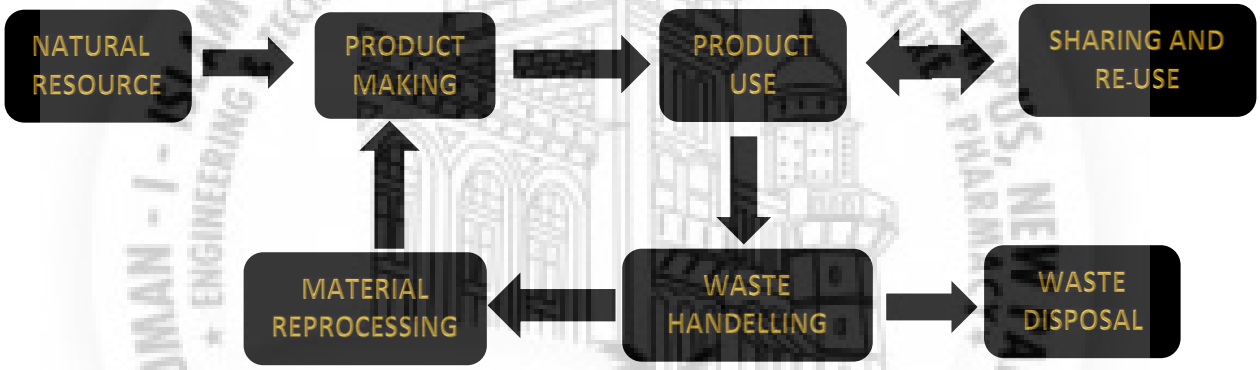
• Energy from waste

Less waste can be generated by reducing the materials used in making and packaging goods. Product and packaging design can also make recycling easier or harder – for instance in whether single materials are used or composites. Reducing input costs has driven many firms to innovate for more lightweight products, but other commercial considerations can lead to over-packaging or to using composite materials. An additional incentive to reduce materials use could be 'producer responsibility'. This includes various forms of obligation for producers either to take back waste arising from their products, or to pay for the cost of managing the waste.

Circular Economy

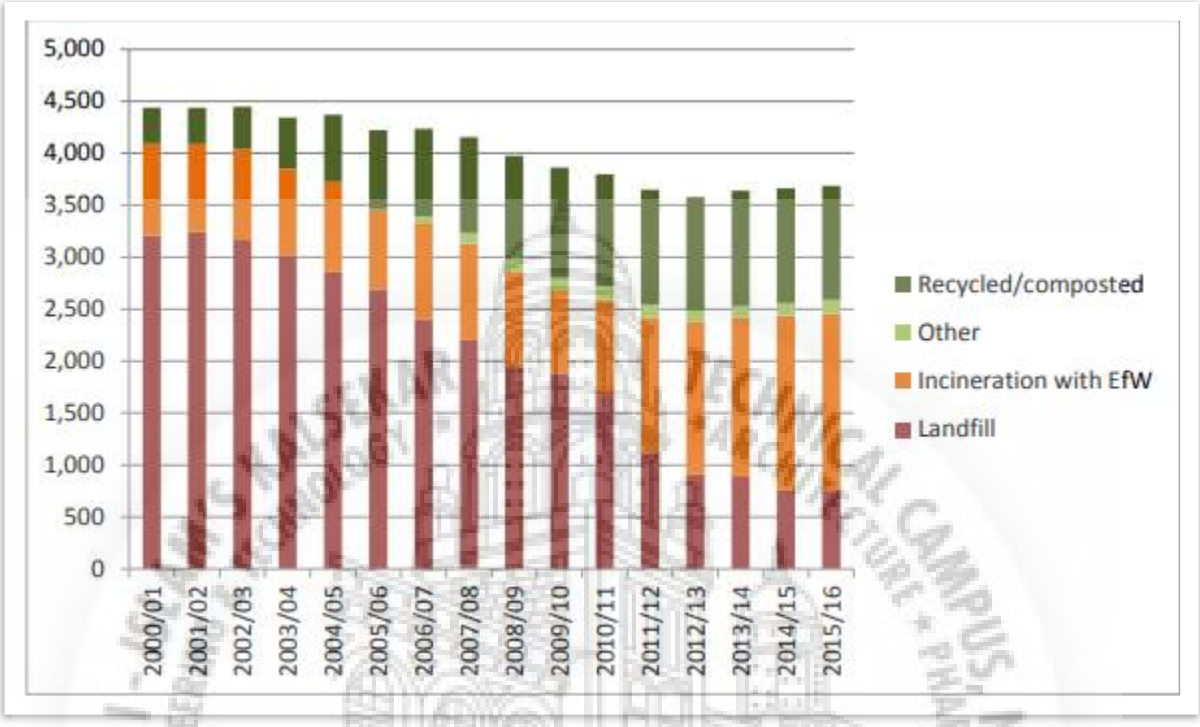
Another newer way of thinking about waste management contrasts a circular system with a linear. The old linear system extracts materials, uses them once, and discards them. This depletes natural resources and brings high economic and environmental costs per use.

A circular system cycles between use, re-circulation and use again. Extraction of new materials and waste disposal are both minimized, bringing economic gains such as reduced exposure to commodity prices, as well as environmental and sustainability benefits.



Since 2000, landfill (at the bottom of the hierarchy) has reduced considerably, but in recent years, waste reduction and recycling (high to medium in the hierarchy) have stagnated and further waste diverted from landfill has instead shifted to incineration (low in the hierarchy).

Stagnation in London's recycling and the rise of incineration.



Source: Defra Local Authority Collected Waste Statistics

5.7 Environment and Sustainability

5.7.1 Climate Change

London's climate is changing year by year. City having hotter, drier summers and warmer, wetter winters. It also having extreme weather like heavy rainfall and heatwaves more often. Most scientists agree that this is caused by human actions that emit greenhouse gases like carbon dioxide. According to BBC news, climate is already changing, and is expected to change even more, as a result of the amount of greenhouse gases have released into the atmosphere. This will be experienced as changes to city's average weather and the frequency and intensity of extreme weather. They expect London's summers to become hotter and drier and by the middle of the century, an average summer will be a fifth drier and an average summer's day 3°C warmer.

Heatwaves will be more likely and be even hotter. Winters, by contrast, will be milder, but wetter, with very heavy rainfall periods becoming more frequent.

The 128-page plan is the second iteration of the UK's National Adaptation Programme (NAP), which sets out the government's approach to dealing with current and future climate change. The first NAP was published in 2013; the new version covers 2018 to 2023. Adaption aims to reduce vulnerability to the impacts of climate change that are inevitable due to past and current greenhouse gas emissions. Adaptation policy in the UK is a devolved matter. Therefore, the adaptation plan mainly covers England, as well as some wider UK matters.

5.7.2 Green Buildings

By the end of 2016, London recorded highest number of Green building in the world after Paris and Singapore. London has 33 LEED certified buildings and 1696 BREEAM certified buildings which makes London a central hub of sustainable and green building construction.

7 More London Building Known as London's most eco-friendly building, the 40,000 sq ft. floor space is occupied by PwC. This building is certified by BREEAM for sustainable and eco-friendly construction. The building is highly intelligent as the IT system here allows every worker to control the luminance and temperature at their workstations. This building has 4,500 seats and a staff of 6,300 has been involved in various initiatives like using 80 per cent recycling waste, recycling wasted heat to maintain the temperature of the building, reusing cooking oil and usage of solar thermal panels on the rooftop.

5.7.3 Energy efficiency

Greater London is home to more than 8.5 million people and 976,000 businesses 6 ; as a result it consumes a great deal of energy. In 2013 total final energy consumption stood at 132,000 Gigawatt hours 7 equivalent to a pile of coal that would cover the One Canada Square tower in Canary Wharf. Ofcourse London is no longer powered by coal; our final energy use breaks down into 47% mains gas, mostly used to provide heat and hot water to our homes and businesses, 31% electricity, and 22% road fuels and solid fuels used in industrial processes. Total gas and electricity consumption is split fairly across both domestic and business users with the majority of other fuel used to drive private transportation.

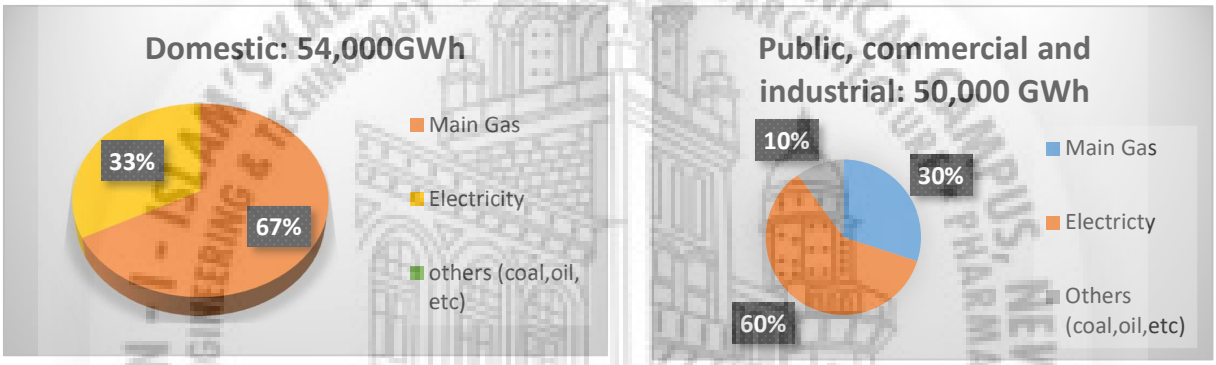
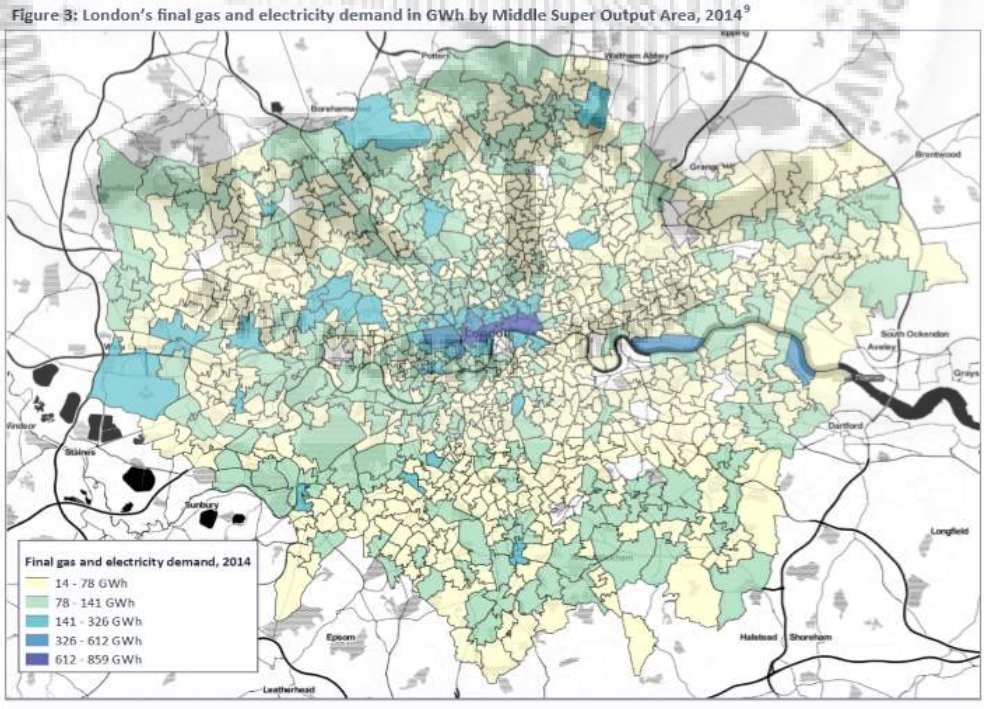


Figure 3: London's final gas and electricity demand in GWh by Middle Super Output Area, 2014[9]



Picture source: Energy Efficiency in London city.org

5.7.4 Pollution

Air Pollution

London is well developed city in all aspects including industrial and many more sector. Air pollution affects everyone who lives and works in London. The most vulnerable groups like children, older people and those with heart and respiratory conditions are most affected. People living in deprived areas are also more affected by poor air quality, partly because these areas are often near busy roads. The two major constituents of air pollutants are particulate matter (PM) and Nitrogen dioxide (NO2) are most concern in London. Particulate matter are seriously effect on heart and lungs it is linked asthma and sometimes death. At high concentrations, NO2 can inflame the airways and long-term exposure can affect lung function and breathing - it can also worsen asthma.

Picture: Smog in winter season (source: google)

Water Pollution

Second source of pollution after air pollution is water pollution. It can be difficult to know if a water body has been polluted. If it is at a river, lake or pond you visit regularly you will have a good idea what the typical state is. It's important to report pollution so it can be recorded by the body that enforces the law, the Environment Agency.

Wealdstone Brook, Brent. Ongoing. This drain is only meant to flow when it rains as it takes rain from roofs and roads. It smells very strongly of sewage (ammonia/nappies). The white substance is sewage fungus. These are feathery fronds of bacteria that feed on the nutrients in pollution. Properties have illegally connected toilets to this drain. It could be several homes, or one larger property (in London we've seen a Care Home, a school and block of flats).

The poor old Wealdstone Brook again, in Woodcock Park, Brent. Local people had been complaining for many years about the pollution of their river. The photo shows a fatty scum on the surface. Investigations discovered a number of misconnected properties. There is also a problem with raw sewage getting into the surface water system when blockages form.

Picture: Wealdstone Brook drain (rooftop and toilet water)

Picture: Wealdstone Brook drainage

The Olympic Park large wetland pond. May 2020. The first of the pollution events in May followed some heavy rain. This looks like a Combined Sewer Overflow. Sanitary waste is present. London Waterkeeper is investigating if a CSO was to blame. If it was then the discharge is legal, but we want Thames Water to notify people when it happens. An upgrade in infrastructure might be needed.

Water stagnation and water pollution problem

5.8 Smart city initiative

Smart city initiative is consider in many ways in London including smart energy, modern techniques of tele-communication and traffic and congestion. The City of London Corporation's next step into Smart City IoT, a 12,000-unit smart street lighting deployment, was launched to the media in November 2019 at the Corporation's head offices at the Guildhall. The City of London Corporation provides local authority services to those located in the City of London, commonly known as the Square Mile, the financial district and historic centre of London. The residential population itself of approximately 8,000 people is surprisingly small but, with more than half a million people commuting into the City every day for work and millions of tourists visiting every year, it is a hive of activity. Many projects are done and many are in processing to make city totally Smart city and AI based technology city.

Undertaken in conjunction with Itron, Urban Control and Wi-Sun, the two-year project is expected to be completed later in 2020. The programme uses field area network (FAN) technology with self-forming and self-healing functionality, as well as Urban Control's software to comply with the

City's stringent requirements. The deployment uses multiple gateways to ensure connectivity with additional redundancy. Itron played an instrumental role by supplying the communications equipment for the project, delivering in-field performance based on open standards communications technology. The project uses LED luminaries and a Central Management System (CMS), allowing the City to use tunable settings to best show its historic assets.

New street lighting helps reduce maintenance costs and energy consumption as well as offering increased flexibility for aesthetic lighting and improved public safety. As a result, the City now also has the capability to enable new programmes such as environmental monitoring.

Future plans and developments

The City of London is in the early stages of its Smart City development but it's evident that the open standards support of the technology and the flexibility to integrate new, third party devices were a key factor in its final decision. Traffic and parking monitoring, occupancy sensing and environmental monitoring are all part of the Corporation's long-term plan.

The additional capacity of the network, says Radford, means that because the streetlights use about 10% of the available capacity the Corporation has about 85-90% to play with for future technology and to deliver core functions for the City of London.

"We're in the modern era – it's all about data. But what we wanted to do is create the infrastructure which allows us to pick the data we want. Rather than big data coming to us and trying to filter out what we need, we wanted to control it to take it forward.

"For example, a hot topic at the moment would be air quality. We can install air quality sensors out on the street to measure air quality, but in locations that we think would work best in terms of collecting that data. Traffic sensors means we can have real-time monitoring of our traffic network. We don't have to wait for others to tell us where the congestion is; we will know before anybody else knows and we can manage that process. We can also use the information for projects when we're trying to work out whether a road is busy or fully utilised or if it can be used for another purpose. This data will help support that as well.

There are also sensors we can add that cover usage of parking bays or waste bin collection. There are many options. The sensors tell us when things are full, when they've been used, how often they've been used or how we can make changes to our cyclical maintenance regime – which saves the Corporation money but also drives best practice.

The mesh technology has provided us with a robust platform for the street lighting aspect. It's worked really well, hasn't let us down. It's a good system that gives us an element of scalability as well so we can add new sensors to interact with.

"It's easy to use, so now we can start to add other sensors and have a rounded smart city solution, but all linked to one place, with one click of a button and collecting key data for the Corporation."

Source: google

5.9 Conclusion and Lesson learnt

- London is a leading global center for professional services. London is the headquarters for four of the world's six largest law firms and is a leading international centre for legal services.
- London's largest industry remains finance, it is the largest financial exporter in the world which makes a significant contribution to the UK's balance of payments. In the 2017 Global Financial Centres Index, London was ranked as having the most competitive financial center in the world.

- Tourism is one of London's prime industries. London is the most visited city in the world by international tourists with 18.8 million international visitors forecast in 2015 which contributes to city's GDP.
- With the growing number of technology companies are based in London, notably in East London Tech City also known as Silicon Roundabout. Investment in London's technology sector was $2.28 billion in 2015, 69 per cent higher than the $1.3 billion raised in 2014. Since 2010, London-based technology companies have collectively raised $5.2 billion of venture capital funding. A report by EY highlighted the importance of London to the UK's FinTech industry in terms of availability of expertise and demand for services. Technology plays vital role in making London as smart city.
- London has an integrated public transport system operated by transport for London under a single electronic ticketing system, the Oyster card. The city's network successfully provided transport for the 2012 Summer Olympics. It includes the London Underground, London Overground, Docklands Light Railway, London Buses and London River Services. A ring of 18 railway stations provides train links to cities, towns and villages around the country as well international services to Paris, Brussels and Amsterdam via the high-speed Eurostar. The Thameslink rail network is undergoing a £6bn programme to upgrade and expand the line.
- Energy efficiency and Green Building speculations contributes in environmental and sustainability of London city.
- Air Quality Index of London is excellent just because the well planned and proper development in all sector including industrial area, energy resources, etc. In 2020, Air Quality Index measures 19 AIQ.
- Energy production and Waste Management are well planned in London city. Recycle of Waste generated by city is use in many aspects including energy production.
- London's architecture become inspiration to all other cities in world.

CHAPTER 06: ANALYSIS OF WASHINGTON DC

6.1 Introduction

Washington, DC., D.C. in full **District of Columbia**, city and capital of the United State of America. It is coextensive with the District of Columbia (the city is often referred to as simply D.C.) and is located on the northern shore of the Potomac river at the river's navigation head—that is, the transshipment point between waterway and land transport. The state of Maryland borders the District of Columbia to the north, east, and west, and the state of Virginia borders the District on the southern shore of the Potomac River.

Washington DC has a humid subtropical climate with a hot and humid summers and cold winters. The city lies on the Potomac River, bordered by the beautiful Blue Ridge Mountains with proximity to the Atlantic Ocean

Name of city: WASHINGTON
Country, Continental: UNITED STATE OF AMERICA NORTH AMERICA
Area: 184,827M^2
Population: 7,614,893
Population Density: 39.6/KM^2
First Settled: 1889
Declared Capital in: JULY 16, 1790
Planned / Unplanned: PLANNED CITY
Government of Country: Federal constitutional republic
Elevation above MSL: 50m
HDI (and HDI Rank) of Country: 0.920 (15th Rank)
Nominal GDP per capita of country: $65111 (7th)
Languages: English, Spanish and etc.

6.2 Land Use

The Land Use Element is the cornerstone of the Comprehensive Plan. It establishes the basic policies guiding the physical form of the city, and provides direction on a range of development, conservation, and land use compatibility issues. The Element describes the balancing of priorities that must take place in order to accommodate a multiplicity of land uses within the boundaries of the District of Columbia. The critical land use issues facing the District of Columbia are addressed in this element.

These include:

• Promoting neighborhood conservation

• Creating and maintaining successful neighborhoods

• Strengthening Downtown

• Enhancing neighborhood commercial districts and centers

• Balancing competing demands for finite land resources

• Directing growth and new development to achieve economic vitality

While minimizing adverse impacts on residential areas and open space

• Siting challenging land uses.

Land use changes have the potential to make the city more vibrant, economically healthy, exciting, and even more environmentally sustainable than it is today. However, without proper direction and coordinated public investment, change can also be adverse. The Land Use Element strives for positive outcomes in all parts of the city by setting policies on appropriate uses and densities, and describing how different uses can successfully co-exist.

The Element is divided into several sections. The first section provides basic data on land use and density in the District of Columbia. Subsequent sections of the element present policies and actions, organized under the following major topic headings: • Shaping the City • Creating and Maintaining Successful Neighborhoods • Balancing Competing Demands for Land.

6.2.1 Land Use Profile of DC

The DC comprises 69 square miles, including approximately eight square miles of water and 61 square miles of land. Land use patterns, illustrated in Map 3.1, reveal an expansive city “core” of

about four square miles centered on the open spaces of the federal city. The core is surrounded by an inner ring of moderate to high density residential and mix use neighborhoods, extending west to Georgetown, north to

Columbia Heights and Pet worth, east across Capitol Hill, and south to the

Anacostia River and Near Southwest. Beyond the inner ring is an outer ring

Of less dense development, characterized largely by single family housing

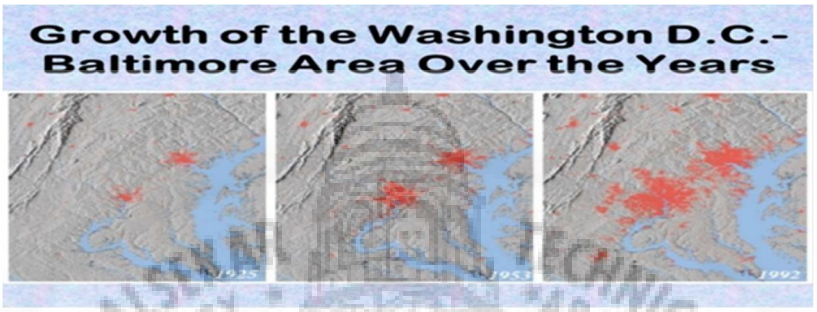
In addition, garden apartments. The two rings generally correspond to historic

Development patterns, with most of the inner ring developed prior to 1910

Moreover, the outer ring developed after 1910.

ELEMENTS	CAPITOL HILL	CENTRAL WASHINGTON	FAR NORTHEAST AND SOUTHEAST	FAR SOUTHEAST AND SOUTHWEST	LOWER ANACOSTIA WATERFRONT /NEAR SOUTHWEST	MID CITY	NEAR NORTHWEST	ROCK CREEK EAST	ROCK CREEK WEST	UPPER NORTH EAST	CITY WIDE	PERCENT
Road of way	759.0	898.8	1337.8	906.1	477.5	628	715.9	1311	1760.5	12231.1	10017.7	25.5%
Single family Detached Homes	6.2	0.1	775.2	163.8	7.3	15.5	83.3	918.9	2324.4	641	4936.2	12.6%
Single family attached homes/Row House	520.2	9.7	641.2	327.8	30.5	496.8	339.9	606.1	290.0	611.4	3873.6	9.9%
Low-rise apartment	43.1	9.7	435.9	555.2	106.1	136.2	109.7	85.1	185.4	189.3	1855.7	4.7%
High-rise apartment	3.9	25.8	1939	43.7	25.6	59.5	65.4	24.7	109.2	24.6	402.3	1.0%
Commercial	97.2	447.9	128.9	62.8	122.0	144	220.1	106	170.1	295.6	1794.6	4.7%
Industrial	5.2	16.4	12.2	5.5	42.2	20.6	5.7	15.7	0.0	294.9	418.4	1.1%
Local public facilities	72.1	47	154	441.1	46.7	53.8	75.4	131.3	67.5	102	1190.9	3.0%
Federal facilities (excl. Parks)	47.3	480.6	4.4	1067.3	408.6	1.3	1.1	412	282.6	75.8	2781	7.1%
Institutional	42.1	66.6	71.2	117.4	22.4	141.7	248.6	163.3	658.9	729.8	2262	5.8%
Permanente open space	295.8	678.5	1321.5	729	532.8	140.9	354.4	877.9	2011.3	1038.1	7980.2	20.3%
Rail utilities	0.7	36.0	223.5	74.5	11.1	96.8	6.3	83.2	3.8	320.9	856.8	2.2%
Vacant	65.6	58.2	178.9	188.2	50.9	36.0	32.6	22.2	111.2	99.0	842.8	2.1%
TOTAL LAND	1958.4	2776.4	5304.6	4686.8	1883.7	1971.1	2258.9	4757.4	7982.2	5645.5	39225	100.0%
Water	117.0	509.2	135.5	1791.4	1294.4	45.8	239.4	18.9	313.0	89.1	4554.2	
TOTAL	2075.4	3284.5	5440.1	6473.8	3178.6	2016.9	2498.3	4776.3	8287.7	5734.6	43766.2	

Land use classification



Picture: Urban growth of D.C. over the years

6.2.2 Governance and Municipality

US Department of Housing and Urban Development is the principal Federal agency responsible for programs concerned with the Nation's housing needs, fair housing opportunities, and improvement and development of the Nation's communities.

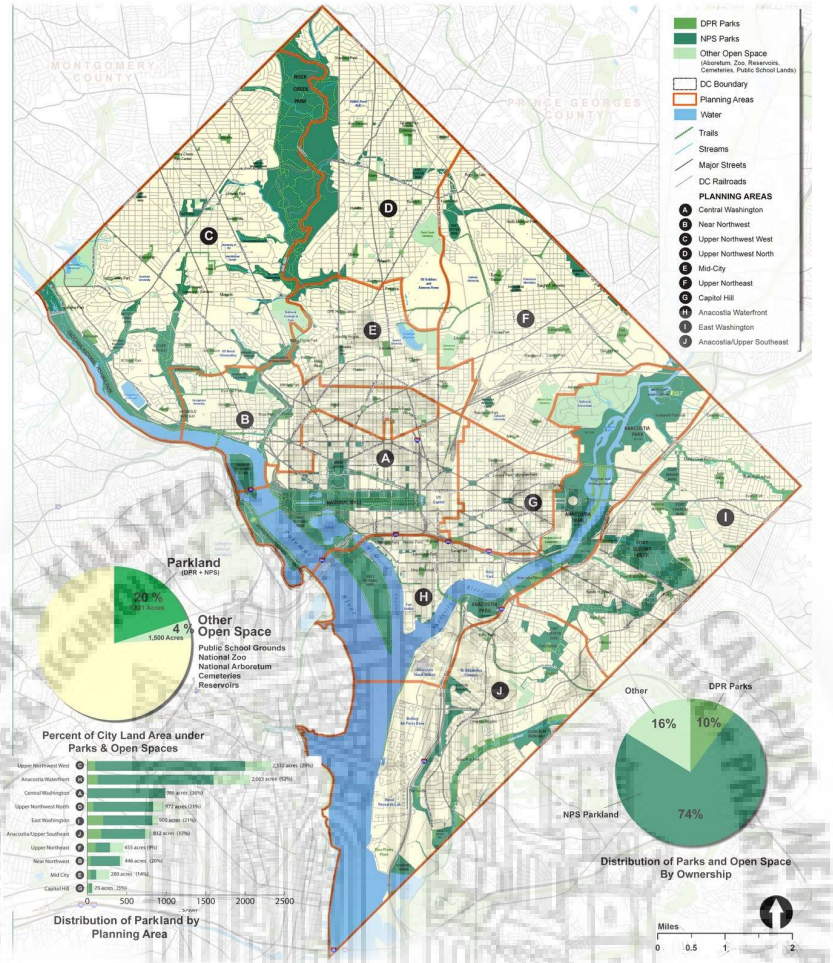
In carrying out its responsibilities, the Department administers a wide variety of programs, including Federal Housing Administration mortgage insurance programs that help families become homeowners and facilitate the construction and rehabilitation of rental units; rental assistance programs for lower- income families who otherwise could not afford decent housing.

It also includes:

(i) Development of urban development strategy
(ii) Preparation of urban, structural and general plans, pertinent to the cities, urban and rural communities
(iii) preparation of planning criteria and regulations for all planning patterns of the land uses
(iv) Zoning to be acquired for the public interest and etc.

6.2.3 Open and Green Spaces

Parkland comprises approximately 20 percent of Washington's land. Almost 90 percent of parkland — more than 6,700 acres, including Rock Creek Park, the National Mall, Anacostia Park, and the Fort Circle Parks — is under the National Park Service's jurisdiction. Another ten percent is owned and managed by the government of the District of Columbia's Department of Parks and Recreation. The remaining 1,500 acres of open space, including the National Zoo, National Arboretum, public school playfields, and cemeteries, are owned and managed by various federal and local agencies.



Distribution of Parks and Open/Green spaces

NPS manages more than 350 properties covering over 6,700 acres in the District of Columbia. These include most of the city's major and well-known parks, such as the National Mall,

President's Park, Rock Creek Park, Anacostia Park, and C&O Canal National Historical Park, and approximately 200 circles, squares, and triangles formed as part of L'Enfant's original street layout for the city. Seven NPS management units have administrative oversight of their properties in the District, each with a superintendent reporting to the NPS National Capital Regional Office. While focused primarily on resource conservation, the programming of the NPS parks also reflects the national capital context, including annual cultural events, commemorative sites, and first amendment activities, as well as passive and active recreation.

The District of Columbia's Department of Parks and Recreation (DPR) oversees much of the non-federal park space in Washington that is principally located in neighborhood parks. It relies on multiple agencies and park partners to plan, build, maintain, and program their public spaces. DPR is focused primarily on providing active recreational programming to District residents, and many of the park sites include fields, playgrounds, and community recreation centers offering a variety of activities including aquatics, arts, childcare, senior services, and therapeutic recreation.

(Rock Creek Park)

(US Botanic Garden)

6.2.4 Cultural Places/ Recreational Spaces

The United States Capitol Building is located in Washington, D.C., at the eastern end of the National Mall on a plateau 88 feet above the level of the Potomac River, commanding a westward view across the U.S. Capitol Reflecting Pool to the Washington Monument 1.4 miles away and the Lincoln Memorial 2.2 miles away.

The U.S. Capitol is among the most architecturally impressive and symbolically important buildings in the world. It has housed the meeting chambers of the Senate and the House of Representatives for over two centuries. Begun in 1793, the U.S. Capitol has been built, burnt, rebuilt, extended and restored; today, it stands as a monument not only to its builders but also to the American people and their government.

(United States Capitol Building)

Anacostia Community Museum

Shining a lens on urban life, the Anacostia Community Museum examines, documents and interprets the impact of historical and contemporary social issues on communities. However, the museum didn't always focus on global communities, as the museum owes its roots to Anacostia's local African American history and culture.

The museum is located a mile from the Anacostia stop on Metro's Green Line in DC's Anacostia neighborhood. It is also serviced by taxis and ride-sharing options like Uber and Lyft. The museum offers free parking and, in summertime, a free round-trip shuttle that picks up at the National Mall and Anacostia Metro station.

After opening in 1967, the Anacostia Neighborhood Museum – as it was known then – helped tell the history and experience of its surroundings, largely African American neighborhoods. After the National Museum of African American History and Culture was announced, the museum took its local community focus and applied it more globally. It changed its name to the Anacostia Community Museum in 2006 to magnify ethnic themes and social and cultural issues occurring within urban communities.

African American history and culture at the museum

Even though the museum has broadened its focus in recent years, its collections contain thousands of unique artifacts related to the local African American community. From family archives of 19th-century African American locals to works from black DC artists, the artifacts highlight how inextricably linked the museum is to its local surroundings. These relics have been used in exhibits and continue to tell the story of east-of-the-river communities in DC.

6.3. Transportation Infrastructure

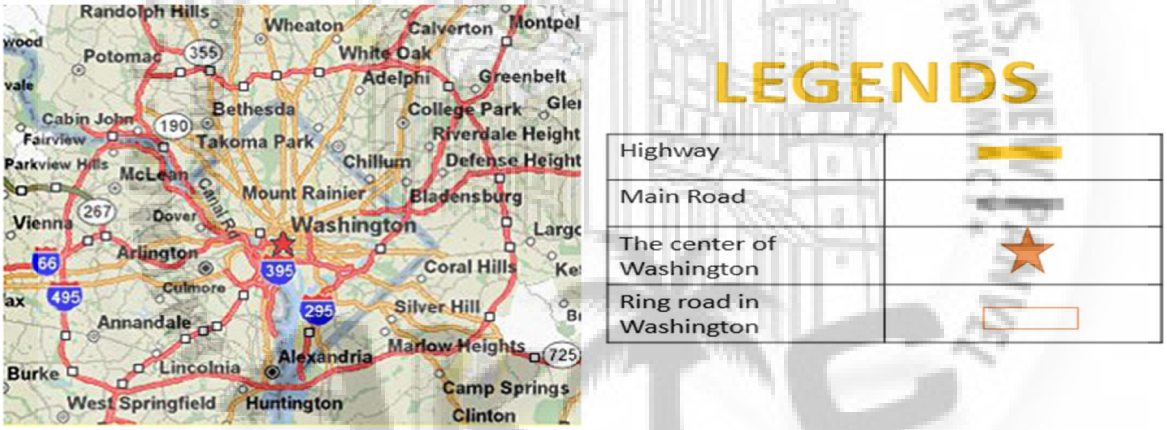
6.3.1 Road System

The city of Washington was designed on a grid. At its center is the US Capitol. The streets running north and south are numbered, and the east-west streets are lettered beginning at the Capitol and extending in both directions.

The city is divided into four quadrants: Northwest (NW), Northeast (NE), Southwest (SW), and Southeast (SE). The quadrant boundaries extend north, south, east, and west from the Capitol along streets appropriately named North Capitol, South Capitol, and East Capitol. (There is no

West Capitol Street because it would run through the center of the National Mall.) The horizontal lettered streets extend consecutively north and south from East Capitol Street and the Mall—thus, one block north of East Capitol Street is A Street, Northeast, and one block south is A Street, Southeast. The vertical numbered streets run consecutively from North and South Capitol streets to the east and west—meaning that one block west of North Capitol is First Street, Northwest, and one block east is First Street, Northeast.

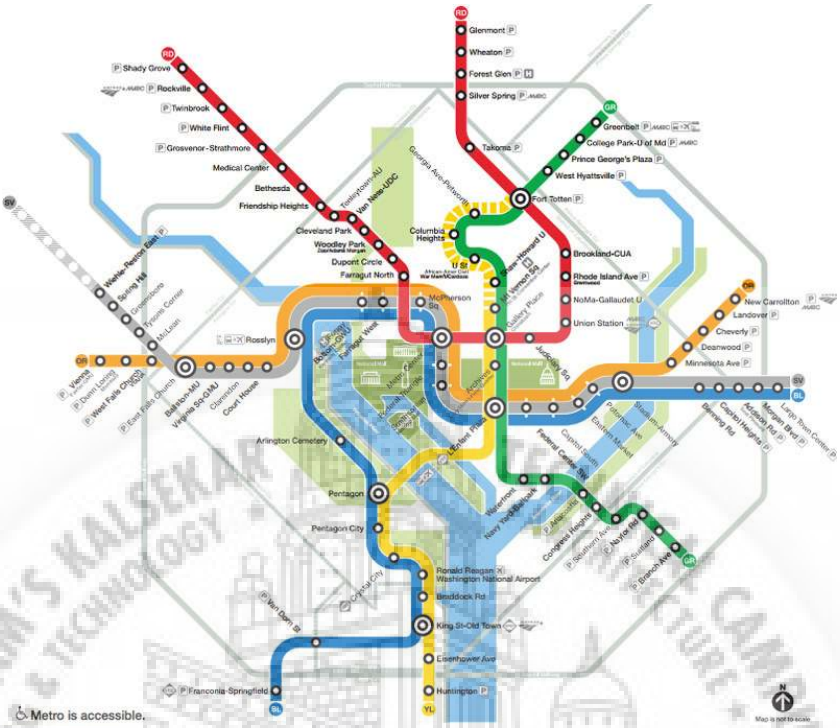
Apart from the numbered and lettered streets, which run neatly on the grid system, there also are state streets—such as Pennsylvania Avenue, where the White House is located—that intersect the lettered and numbered streets diagonally. Besides Pennsylvania Avenue, the busiest state streets are Massachusetts, Connecticut, Wisconsin, and New York. Addresses on these streets can be a bit difficult to locate without a map but not impossible.



6.3.2 Rapid Transit System

6.3.2.1 DC's Metro

Washington, DC's Metro is one of the busiest public transportation systems in the country. Its expansive network of tunnels and above ground tracks connect all four quadrants of DC with suburban Virginia and Maryland. The system is heavily used by local commuters and it's a popular, convenient and affordable way for visitors to DC to get around the region.



The Metro consists of six color-coded lines: Red, Blue, Orange, Yellow, Green and Silver. The lines are connected to each other via transfer stations and many Metro stops are serviced by more than one color. Each train car has an exterior electronic sign that marks the color and the direction of the train. Direction is indicated by the final station of that line.

Metro fares are calculated by how many stops you travel and vary during peak and off-peak hours. During peak hours, most fares range from $2.25 to $6 per trip. During off-peak hours, fares typically range from $1.85 to $3.85. During peak operating hours (weekdays, 5-9:30 a.m. and 3-7 p.m.), trains usually arrive every 8 minutes. At stations served by more than one line, trains will arrive every 3-4 minutes. At off-peak times, trains come every 12 minutes, while later trains typically arrive every 15-20 minutes.

6.3.2.2 DC's Bus system

Metro bus provides more than 400,000 trips each weekday serving 11,500 bus stops in the District of Columbia, Maryland, and Virginia. Metro bus is the sixth busiest bus agency in the United States, with a fleet of more than 1,500 buses operating on 325 routes.

All buses in the Metro fleet are accessible for individuals with disabilities. They have a low floor ramp or are lift-equipped to make it easier to get on and off. The ramps on low floor buses can be manually operate if the hydraulic system fails. Priority seating for the disabled and senior citizens is located in the seats directly behind the bus operator. Two wheelchair securement areas are located near the front of each bus and include tie downs and lap belts for safety.

Metro bus

6.3.3 Cycling Infrastructure

DDOT's Bicycle Lane program has built 89 miles of bike lanes in the District since 2001. Beginning in 2009, the agency began installing protected bike lanes, also known as Cycle Tracks or separated bike lanes, and there are, as of 2019, 12 miles of these facilities. A protected bike lane has some kind of physical separation between the motor vehicle travel and the bike lane. This can be a row of parked cars, a concrete curb, and/or flex posts and wheel stops. There is growing demand to install more protected bike because many people want a lower stress and more comfortable cycling experience where conflicts with vehicle are removed, or substantially reduced.

In 2020, DDOT is embarking on a plan to build over 20 miles of new protected bike lanes over the next 3 years. This ambitious plan will create a network of protected bike lanes that will allow more people

Bicycle-Friendly Streets of DC

6.3.4 Walkability

Washington, DC is a model for walkable urban development, particularly due to its balanced development of center city and urbanizing suburbs," argues a new report from the Center for Real Estate and Urban Analysis at George Washington University's business school. Released Monday, the report ranks current and projected levels of walkable urbanism in the 30 largest U.S. metro areas based on land-use data and other development metrics, like rent premiums.

Walkable urban places feature high development density, lenient zoning rules, mixed uses, and multiple forms of transportation, according to the authors. A helpful rule of thumb for thinking about walkable areas is whether "destinations such as home, work, school, stores, and restaurants" are within a half-mile or so of a specific point. The report describes "761 regionally significant walkable urban places," or "Walkup's," in the 30 metro areas studied. In both the Boston and D.C. metros, more than 40 percent of occupied Walkup space is located in suburbs seeing development, the report says.

Walkable Area's in DC

6.3.5 Travel time and Congestion

The nation's traffic is bad and getting worse. Drivers in the Washington region are feeling their share of road congestion, spending more time sitting in traffic, on average, than anyone outside of California.

Washington drivers spend 102 hours each year in traffic delays, the third-highest amount in the nation, according to a report released Thursday by the Texas A&M Transportation Institute. The annual study ranks large metro areas using data on speed and traffic volumes.

Traffic in DC, USA

6.4 Housing

6.4.1 Types of Homes

Federal

Federal type

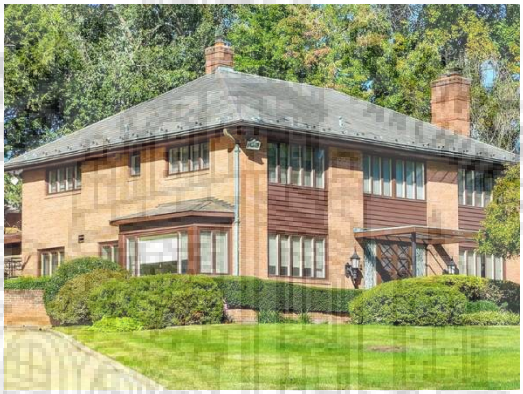
Federal-style buildings are easily identified by their straight lines and simple facades. You can find federal-style row houses and single-family homes. According to Urban Turf, these homes were inspired by Greek and Roman architecture. They can be identified by low stoops and tend to be of modest scale, usually around two stories tall with two or three bedrooms.

Contemporary

Contemporary type

Contemporary homes tend to stick out against the more classic styles in D.C., but you can find these houses throughout the District. According to Urban Turf, they're identified by clean lines, large floor-to-ceiling windows, and wide-open interiors.

Craftsman



Craftsman type

The simple and well-made Craftsman-style home became popular in D.C. in the early 20th century, Urban Turf noted. They are significantly less detailed and ornamented than homes built in the Victorian and Beaux Arts styles. You'll typically find built-in cabinets or shelves, Urban Turf explained, and the Craftsman style is often found in the furniture adorning a house as well. These types of homes "were part of a movement that sought to elevate the craftsman and downplay machinery," UrbanTurf said.

Bungalows

Bungalows type

Bungalows are one of D.C.'s less expected home styles. These homes show off low-pitched roofs with an overhang typically shading a front porch, and are thought to be tropical, showing up in films that are set in places like Hawaii and the coasts of California and Florida. But according to Urban Turf, you can find these one-story homes with their verandas right here in the nation's capital.

Colonial

Colonial type

Colonial-style homes are, unsurprisingly, found in suburbs all around the mid-Atlantic and northeastern states (they're found everywhere in my hometown in Connecticut). These houses have a classically symmetrical facade and will feature a centered front door that sometimes has

pillars or shutters framing it, Urban Turf explained. The windows all tend to have decorative shutters as well.

Tudor

Tudor type

European-looking architecture isn't only reserved for German beer gardens and restaurants in the District. Tudor-style homes typically have pointed roofs with exposed dark wood =with a Medieval feel to them. These showed up in D.C. in the early 1900s and are also known as revival-style.

Victorian

Victorian type

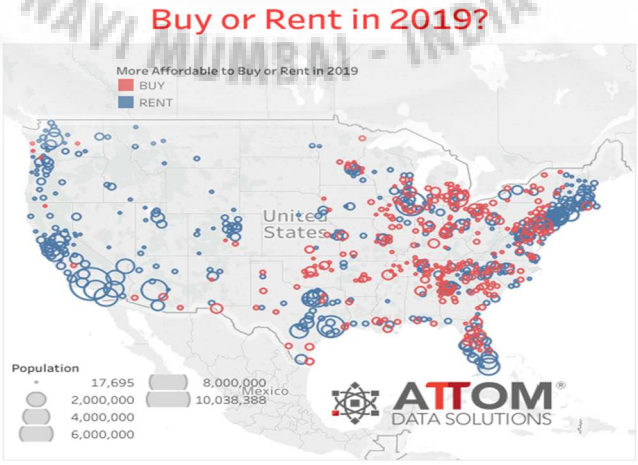
Classic turrets, brick facades, and a grandiose style define Victorian-style homes. These ornamental homes were built in D.C. by folks after they had some money to their names, UrbanTurf explained. Bay windows, peaked roofs, and curvier lines set these homes apart. They are large and often have a carriage house and around five bedrooms.

6.4.2 Affordability in sale and rent prices

D.C. real estate prices have soared as the city has started attracting wealthier residents. As a result, finding an affordable home to purchase may be challenging. According to the National Association of Realtors, the median sales price of a single-family home in the Washington, D.C. metro area is $417,400. That's more expensive than both New York City ($403,900) and Philadelphia ($224,600).

Roughly 220,000 families across the D.C. region could be forced to leave their homes in the coming years as housing costs rise, according to a new study of the area's housing market.

Researchers at the Urban Institute found that people living in 296 communities around the region are at risk of displacement, reasoning that households with lower incomes in areas experiencing rapid property value increases will be particularly vulnerable and could soon be priced out of the market.



6.4.3 Homelessness Rate

The number of homeless in Washington, D.C., grew by 34% between 2009 and 2016, an analysis of HUD by the U.S. Conference of Mayors found. The city has 124 homeless for every 100,000 residents. The high cost of living in the nation's capital is to blame, local experts told the New York Times. Some low-wage workers, especially single mothers with children, simply cannot find stable, affordable housing.

Homeless people in DC

Slums of DC

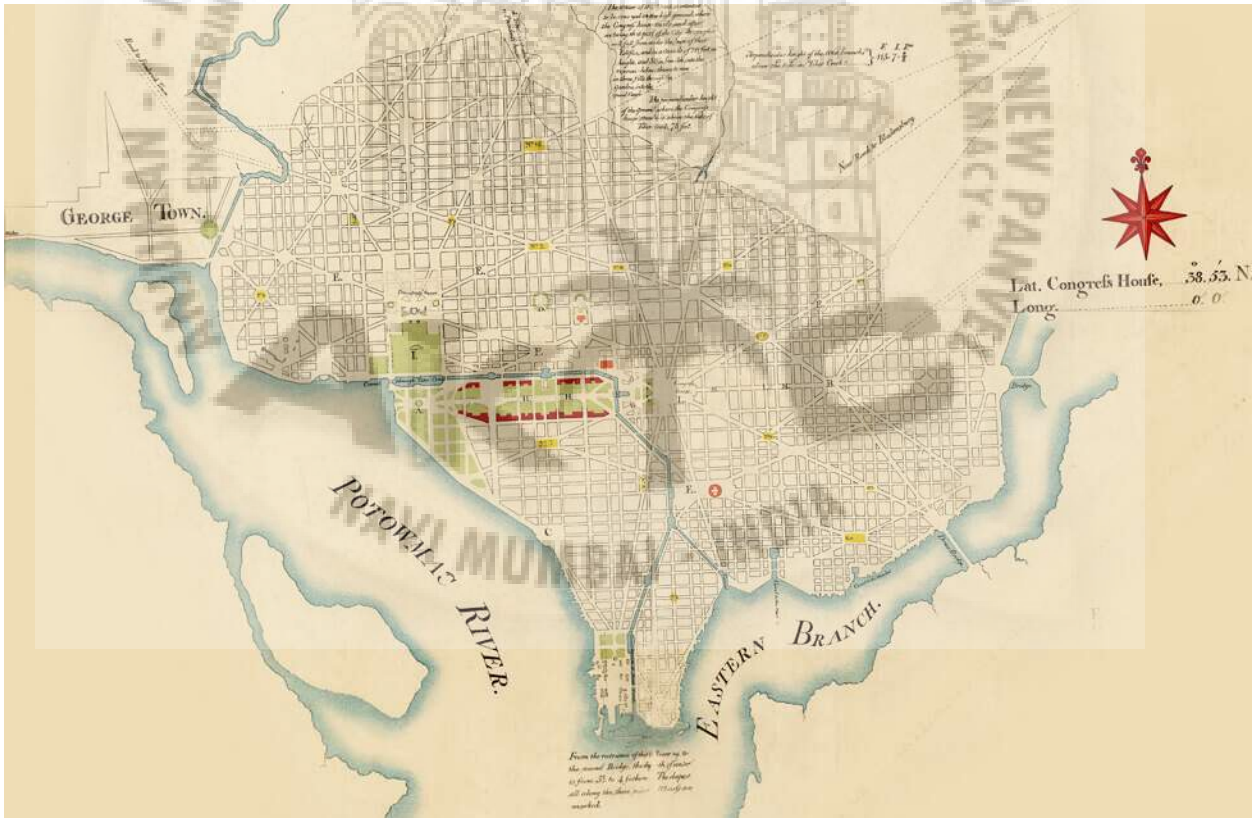
6.5 Architecture and urban design

From any vantage point, Washington, D.C., is a city defined by the geometry of its street plan and by the interrelationships between major public buildings and urban nodes. Within the original L'Enfant City, the street system of radial avenues and grid streets spreads out toward the horizon, punctuated by towers, domes, and obelisks. Only when L'Enfant City merges into the rest of the District of Columbia and then over to the Virginia shore and along the Maryland rim do the forces of geometry lessen, and the built-up city reaches skyward.

The wide radial avenues and major grid thoroughfares knit together the open spaces of the Mall, Rock Creek Park, and the many smaller neighborhood parks scattered throughout the city. From the flatlands of L'Enfant City, the ground rises up through terraces and hills. The open texture of the city and the various vantage points located throughout allow for the viewing of the entirety of buildings and for the full appreciation of their architectural qualities.

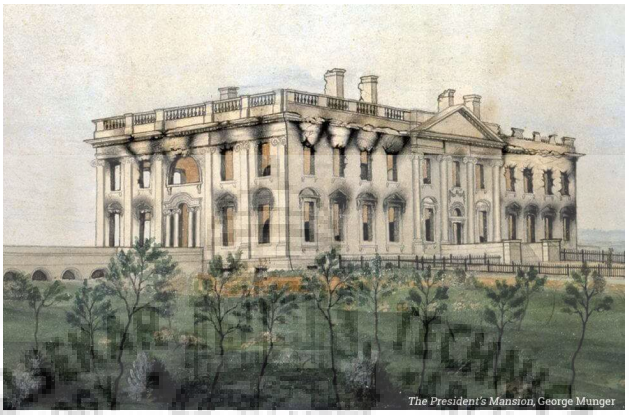
6.5.1 Historical Development

Washington, DC is a planned city, intended to serve as the nation's capital. Throughout the city's history, major plans and significant local and national events have shaped its design and growth. Timelines highlighted in blue indicate NCPC specific historical significance.



In 1791 Pierre L'Enfant set out to create a "magnificent city, worthy of the nation, free of its colonial origins, and bold in its assertion of a new identity." His design proposed an orthogonal, gridded

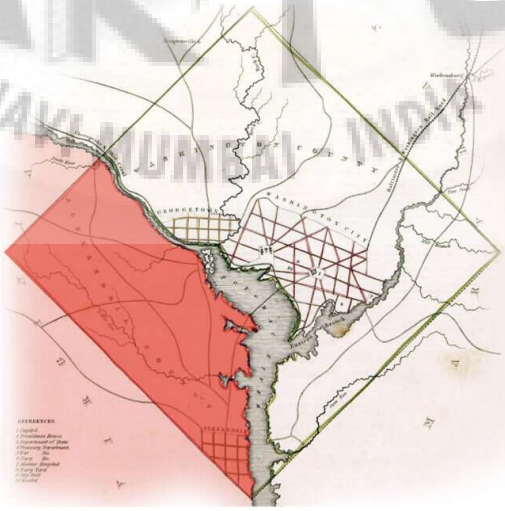
street network with diagonal avenues visually and physically connecting key civic buildings and spaces.



The Burning of Washington

In August 1814, the British burned various government facilities, including the White House and U.S. Capitol, as part of a brief occupation of Washington, DC during the war of 1812. James Hoban, the original architect of the White House, oversaw its rebuilding, while Benjamin Latrobe provided major repairs to the damaged U.S. Capitol. The Marine Corps Commandant's Quarters at 8th and I Streets, SE was one of the few buildings that was not damaged when the British burned Washington, DC and it remains the one federal building to be in continuous use since that time.

Retrocession



The return to the state of Virginia of the land it ceded to the federal government to create Washington, DC, the national capital. The area, formed in 1790 under the name of "District of Columbia," initially consisted of 100 square miles ceded by the states of Maryland and Virginia in accordance with the Residence Act.

National Mall Development

In 1848, construction began on the Washington Monument. However, partially due to a lack of funds, it was not completed until 1884, following a period of no construction that lasted from 1856-1876. Construction began on the Smithsonian Castle in 1849.

Permanent System of Highways

Congressionally legislated, the Permanent System of Highways was intend to create an orderly framework for development beyond the L'Enfant City as Washington continued to grow. Frederick Law Olmstead, Sr. contributed to this plan.

Potomac River Dredging

The U.S. Congress authorized dredging of the Potomac River and reclamation of the Potomac Flats. Potomac Park constructed on reclaimed land.

Height of Buildings Act

Passed by Congress, the act was key in establishing the national capital's horizontal character by setting maximum building heights generally controlled by street widths. The height limit on

residential streets is 90 feet. Height limits on commercial streets is the width of the adjacent street plus 20 feet, with a general maximum height limit of 130 feet (except for 160 feet along portions of Pennsylvania Avenue).

St. Elizabeth's

NCPC approved the master plan for the consolidation of the U.S. Department of Homeland Security Headquarters at the historic St. Elizabeth's campus in southeast Washington. Anticipated to accommodate 4.5 million square feet of space, the east and west campuses are still under construction.

Capital Space

Washington, DC is a city of parks, with more green space per person than any other American city of its size. However, the wide variety of parks, quality, and capacity, along with shared jurisdictional responsibility, resulted in their not meeting the needs of residents, workers, and

visitors. Capital Space, the first comprehensive planning analysis of Washington's parks and open space in almost 40 years, provided a vision for a beautiful, high quality, and unified park system through six big ideas. The plan was a joint initiative of NCPC, the National Park Service, and the District of Columbia.

6.5.2 Features of traditional architecture

Traditional architecture are the identities of any country and this is same with Washington D.C

Three factors have radically influenced the style of Washington's architecture: restrictions on the height of structures, Classicism and conservatism. Yet, in the mid-20th century, Modernism began to have a noticeable effect.

Height restrictions for building in Washington city where in forced by congress as early as 1899 because of over the fire safety and aesthetic of tall building concerns, and the height of a buildings act 1910 a short cities horizontal landscape then according to the add No building in the city may be taller than 130 feet that is 40 meters, the which certain proportions of Pennsylvania Avenue to some structures are allowed to extend their Heights with additional 30 feet that is 9 meters. Office buildings maybe be no wider than the street on which they are constructed + 20 feet that is 6 meters coma and most of them are about 120 feet that is 37 meters wide. Thus, D.C. lacks the characteristics of skyscrapers, which is found in other large cities of US.

Since 1800, the architecture and Designs of many of Washington's building have been inspired by classism that is a style known for rationality beauty order and balance. Classical architecture and Washington has evolved through several stages, success oblique coming under influenced of 18th century Georgian and paladin styles coma 19 century Greek Revival and second Empire styles, early 20th century art deco influenced Neoclassical , mid-20th century modernism comma and ultimately e late 20th and early 21st century postmodernism.

The White House (18th-century Palladian style) and the Capitol (19th-century Greek revival) are examples of some of the early Classical structures.

A tradition of conservatism also is evident in the architectural design of many of Washington's private and government buildings. New architectural styles are rarely employed in Washington until years after the styles have become accepted in other areas of the country. Two exceptions to

this rule were the usage of the Second Empire style of the1850s, particularly in the building that once held the Corcoran art collection (now called the Renwick Gallery), and the postmodern style of the early 1980s, seen in many commercial buildings on Connecticut Avenue near DuPont Circle and on Pennsylvania Avenue in the east end of Georgetown.

Washington, D.C., row houses

6.6 Sanitation Facilities

6.6.1 Water supply

DC Water provides more than **681,000 residents** and **21.3 million annual visitors** in the District of Columbia with retail water and wastewater (sewer) service. With a total service area of approximately **725 square miles**, DC Water also treats wastewater for approximately **1.6 million people** in neighboring jurisdictions, including Montgomery and Prince George's counties in Maryland and Fairfax and Loudoun counties in Virginia.

6.6.2 Sewage Management

DC Water's Blue Plains Advanced Wastewater Treatment Plant is the largest plant of its kind in the world. On an average day, the facility treats close to 300 million gallons of wastewater and has the ability to treat over 1 billion gallons a day at peak flow. Wastewater flows in from the District of Columbia and from Montgomery and Prince George's Counties in Maryland and Fairfax and Loudoun counties in Virginia.

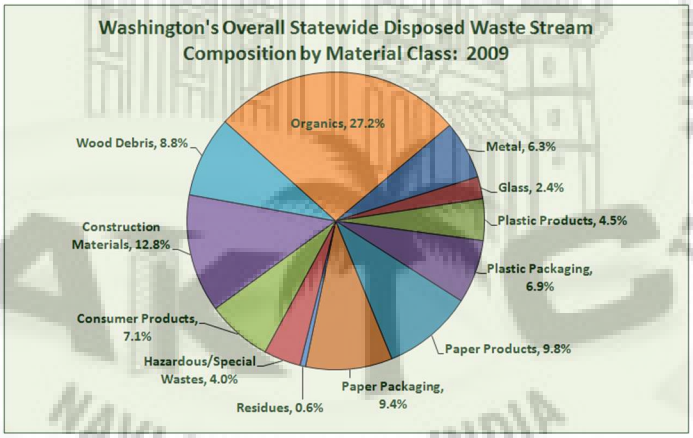
The plant opened as a primary treatment facility in 1937. Since that time, new processes and technologies have been added to provide advanced wastewater treatment. The Blue Plains facility

now uses both primary and secondary treatment as well as denitrification, multimedia filtration and chlorination/DE chlorination during the treatment process.

At DC Water, during the treatment process, useful products like bio solids and energy are extracted to be reused. We land apply our bio solids across the region, recycling nitrogen and phosphorous back into local soils. The thermal hydrolysis process used in our digesters generates about 10 megawatts of electricity that we reuse to cut our electricity consumption by a third. These efforts help to continue to improve our treatment process and remain a leader in sustainability for the future.

6.6.3 Solid Waste Management

Washington State University is committed to the proper management of its solid waste. By diverting its solid waste from the landfills to reuse and recycling programs, WSU is taking steps to reduce its carbon footprint and remain committed to its Climate Action Plan.



The city's recycling rate is still well below the national average of 35% and far below the recycling levels reached by other major cities, some of which are recycling over 70% of their solid waste. DC's non recycled municipal solid waste is sent to incinerators and landfills in Virginia. The city's estimated 25,000 tons of recycled metal, glass, paper and plastic are sent to a Waste Management Inc. facility in Elkridge, MD, where they are processed for markets. Transportation costs the city close to $1 million a year. Processing at this very large materials recovery facility (MRF) is not

efficient, a good percentage of materials, especially glass, and plastic are not recovered but used by Waste Management, Inc., as landfill cover. ILSR contends that the city should contract with a closer-in facility, which is properly scaled for more efficient processing of recovered materials to reduce the costs of recycling. DC pays $120 per ton for recycling. Thirty miles up the road, Baltimore is paying $20 per ton to recycle, less than half of what Baltimore pays to incinerate its garbage, $50 per ton. DC pays $46 per ton to incinerate waste at the Lorton, VA garbage incinerator. The Energy Justice Network has compiled information about the environmental impact of garbage incineration on the District. As always, a highly effective recycling, composting and reuse system needs constant citizen vigilance and participation. The DC Sierra Club Zero Waste Committee, the DC Environmental Network, ILSR and many individual citizens form the nucleus of recycling activism in DC.

Landfill Site D.C (L.R.I)

6.7 Environment and Sustainability

Washington, DC has taken many steps to reducing consumption, reusing materials and recycling eligible waste throughout the city. In January 2010, the District encouraged residents to use reusable bags by implementing a five-cent charge for each disposable paper or plastic carryout bag purchased at a business selling food or alcohol. The majority of the proceeds from the carryout bag fee go into the new Anacostia River Clean Up and Protection Fund.

In January 2016, the city banned the use of food service products made of expanded polystyrene, commonly known as foam. Mayor Muriel Bowser supports “Our Last Straw,” a coalition of businesses, environmental organizations, and residents seeking to eliminate the use of single-use

plastic straws. In January 2019, the District implemented fines for single-use plastic straws and stirrers, which continues to help the city move towards being a leader in sustainability. The Department of Energy & Environment (DOEE)'s RiverSmart programs help to reduce stormwater runoff that harms the District's waterways and the Chesapeake Bay, while also providing financial incentives for District property owners who install green infrastructure such as rain barrels, green roofs, rain gardens and more.

6.7.1 Climate Change

6.7.1.1 Rising Temperatures

Change in climate already caused 2 degree Fahrenheit rise in temperature as compared to 50 years data in Washington DC. Warming more than the average nationwide. By the year 2080 the average temperature in summer of Washington d.c. is expected to hit the historic high of 87 degree Fahrenheit to anywhere between 93 degree Fahrenheit and 97 degree Fahrenheit. These continuous the pattern of rising Washington dc's summer temperatures, as 5 out of 6 of the districts hottest recorded summers have recorded after 2010. This increase in temperatures have an adverse effect on DCS residents health, Rising in the risk of illness caused by heat related, respiratory issues due to drastically increase in ozone, Pollen, and ragweed counts, and increased in diseases spread by mosquitoes due to high biting rates and faster life cycles caused rising temperatures.

6.7.1.2 Shifting rainfall

During the season winter and spring it is expected to rise in rainfall, but it remains largely stagnant during fall and summer. This, when combined with increased temperatures drawing soil, will increase flooding during Spring and winter season but during fall and summer it results increase in draught.

6.7.1.3 Early blooming of cherry Blossoms

Washington Cherry trees are blooming earlier since 1921; the bloom dates have shifted earlier by approximately 5 days. The timing of peak bloom is very important for tourism and local economy because the cherry Blossoms grow more than 1 million people each year, menu of Huma visitors.

6.7.2 Green Building

Washington DC has long been a leader in green building, and LEED has been the rating system of choice in the district for decades.

Local DC government, driven by Sustainable DC, wants to cut the greenhouse gas (GHG) emissions by half by 2032, and become Carbon Neutral by 2050.

The District Clean Energy Plan targets 50% Energy Use Reduction through Net Zero Construction, and 50% sourcing of energy usage from renewable sources.

The proposed DC green code will require Net Zero Energy for residential new construction by 2022 and commercial requirements will be set by 2026.

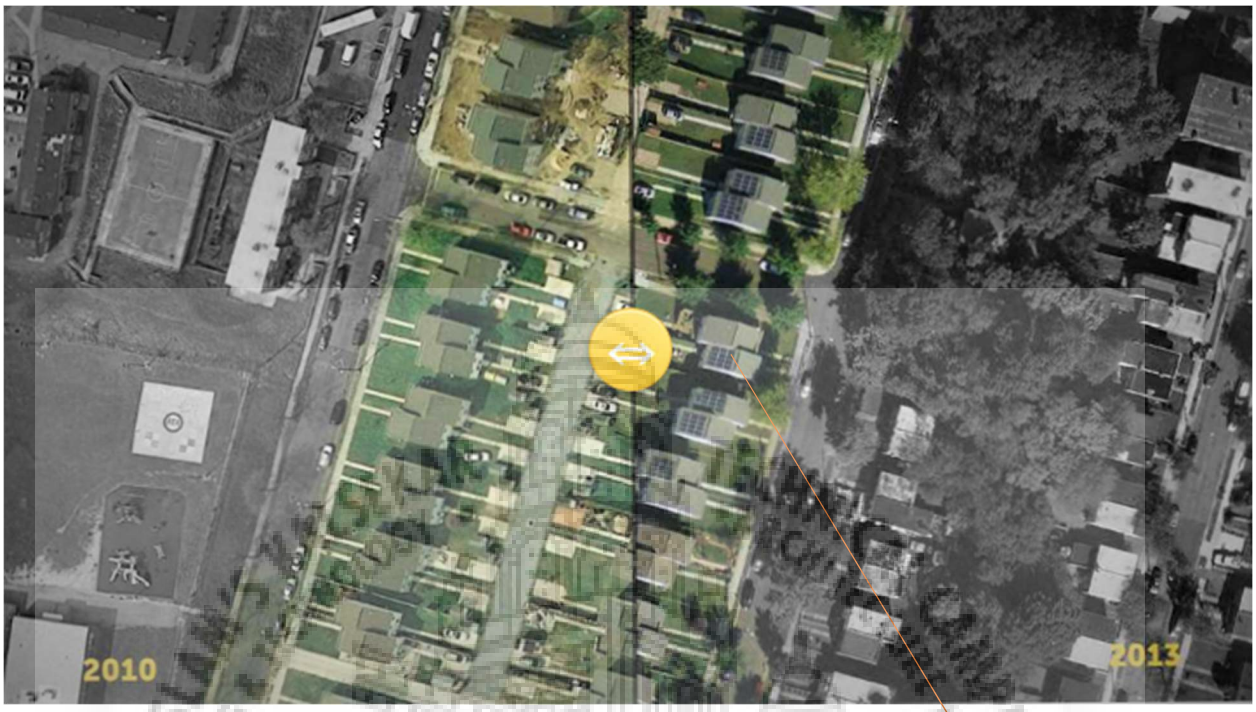
Developers that will ensure consideration for leasing by federal government and government agencies will respond to Net Zero Energy by 2030.

U.S. Green Building Council

Internationally Monitory Fund D.C

6.7.3 Energy Efficiency

Since 2012, the DCSEU has worked with DOEE and local contractors to install more than 500 solar photovoltaic (PV) systems on single-family affordable housing in the District. These systems are generating enough electricity to offset nearly 70% of the energy costs on an average home in DC.



Before Installation of solar panels **Installed solar panels**

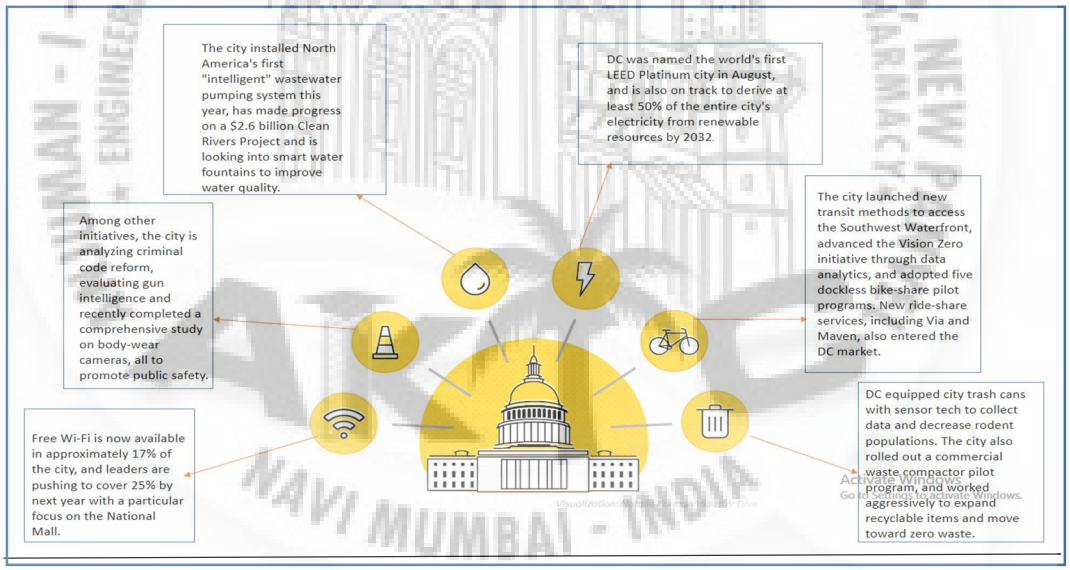
6.7.4 Pollution

WASHINGTON — D.C. is credited with being one of the greenest cities, one of the healthiest cities and one of the wealthiest cities. However, a report issued this week shows it is also one of the most polluted cities. The 2014 State of the Air report, released by the American Lung Association, ranks the D.C. area eighth out of 277 metropolitan areas for high-ozone days. The Los Angeles area ranked first. The U.S. Environmental Protection Agency tells WTOP ozone levels in the country decreased 14 percent between 1990 and 2012. Even so, D.C. just moved up on the most ozone-polluted cities list. In 2013, it ranked ninth; in 2012, it was 13th.

Ground-level ozone, also known as smog, is formed by a chemical reaction that happens when air pollutants, such as those found in vehicle exhaust or factory emissions, react with sunlight.

6.8 Smart City Initiative

In 2017, Washington welcomed a wealth of new, smart developments: It installed North America's first "intelligent" wastewater pumping system, equipped city trash cans with sensors, adopted five dockless bike-share pilot programs, installed free Wi-Fi across 17% of the city and was even named the world's first LEED Platinum city.



6.9 Conclusion and Lesson learnt

- The past decade in U.S. along with its capital Washington D.C. has seen technological advancements, demographic shifts and major changes in public opinion.
- The D.C. region's population keeps growing because of above changes. Most of them are migrants who came in search of work from another's state and countries.
- Planning zones are divided into 3 categories: First includes Residential, Industrial and Urban areas. The second group includes areas of sensitivity such as that of heritage value. The third group Includes community and recreational facilities.
- local decision-makers, politicians and public authorities with responsibility for urban development, environmental management, social affairs and public health; civil society organizations, local initiatives and citizens concerned with the quality of urban settings and the quality of life at the local level.
- Some of the recreational spaces are National Malls and Memorial park and constitution Gardens, while popular shopping malls are Citycenter D.C. Chevy chase pavilion.
- Washington, DC has many faces. It is the home to the U.S. government while being remarkably international with approximately 180 resident embassies and respected global economic and policy organizations.
- The Washington, DC metro area is the strongest economy in the United States.
- Sports in the United States are an important part of culture in the United States. American football is the most popular spectator sport to watch in the United States, followed by baseball, basketball, and ice hockey, which make up the "4 major sports".
- The road system in Washington D.C is in the form of Radial Ring Roads. The major roads suffer from congestion due to increase in number of vehicles in the city. However, the government has undertaken several initiatives such as construction of new roads to counter this.
- Many of those who works and lives in D.C. uses cars, metros, metrobus, and ride their bicycles for daily transport.
- In terms of structure style, we get to see mixed pattern with row houses along with apartments and bungalows and offices buildings.
- In 2017, the District was the first city in the world to be LEED-certified.

CHAPTER 7: CASE STUDY 1- OPEN AND GREEN SPACES: BENEFITS OF OPEN SPACES AND GREEN INITIATIVES IN PARIS

7.1 Introduction

In the scope of United Nations 2030 Agenda, public and green spaces play a vital role in the promotion of cities' sustainability and citizens' well-being, namely, in the connection between human and nature and also through multiple benefits to human and environmental health.

As a result of development based only in the economic dimension which neglected the deterioration of the natural environment, nowadays, cities are facing social and environmental challenges that compromise their sustainability. Urban green spaces are extremely necessary, particularly in developing countries like India and China, where climate issues such as air pollution levels are extremely high. They play an important role in purifying air, thus improving the air quality and controlling the urban heat island phenomenon.

7.2 Benefits of Open and Green Spaces

Strategic planning, design and management of urban green spaces can increase their potentials and thereby their benefits.

i) **Economic benefits:** Urban green spaces have long-term positive effects on the economy but can also generate more direct economic benefits and values through increased property value, urban agriculture and city branding.

ii) **Health benefits:** Urban green spaces provide a number of benefits for human health, including physical and mental well-being, and child development, all important for sustainable social development.

iii) **Quality of life benefits:** Green spaces increase the attractiveness of urban areas, providing possibilities for increased quality of life in terms of social interaction and attractive living and working environments. Many urban green spaces are freely available to all, regardless of social and economic status. They thereby have a special role as meeting places, counteracting social injustice in society.

iv) **Environmental benefits:** Urban green spaces can play a role in reducing pollution. Vegetation, mainly the local presence of trees and shrubs, has air purification and filtration capacity. Parks are generally between 1°C and 4°C cooler than the rest of the city.

7.3 Desired Open and Green Space Qualities

The qualities which should be considered in planning open and green spaces of a city are:

i) Quantity: Targeting a total percentage of the jurisdiction's land area to be set aside for parks, or protecting a total percentage of the land in any new development as open space.

ii) Proximity to where people live, work, commute and spend time is a determinant for use and health, supported by mixed land use with a combination of built structures and green spaces.

iii) Distribution and Equity: Arranging park locations to ensure balanced service across geographic areas. Providing facilities and programs evenly across socioeconomic populations.

iv) Maintenance and upkeep to a high quality support several urban green space benefits associated with a well-kept character, including economic and quality of life benefits.

v) Possibilities for **people to be involved** in green space development through gardening or participatory processes can improve the functions of urban green spaces and their benefits for people.

7.4 Monitoring Effectiveness of Green Spaces

The effectiveness of green spaces can be assessed in a variety of ways, such as by asking the users the following questions.

Impacts	Suggested questions to pose to establish the information
Environmental/ ecological impacts	1. What is the impact of the urban green space on air quality, noise or urban heat exposure? 2. Does it support water sources? 3. Does it enhance biodiversity?

Lifestyle impacts	1. Does the urban green space support/increase physical activity levels? 2. Does it increase the time people spend outdoors? 3. Does it support healthy lifestyles and active recreation?
Social impacts	1. Does the urban green space support or enhance social cohesion? 2. Does it promote social interaction and exchange? 3. Does the development of a green space lead to displacement of local residents?
Equity impacts	**3.** Do all population groups make use of and benefit from the urban green space? **4.** Does the urban green space enable different functions for different user groups?

Table: Impacts to consider in monitoring and associated questions

7.5 Case Study of Paris: "License to green" and Rooftop farms in dense urban areas

Dense Urban layout of Paris

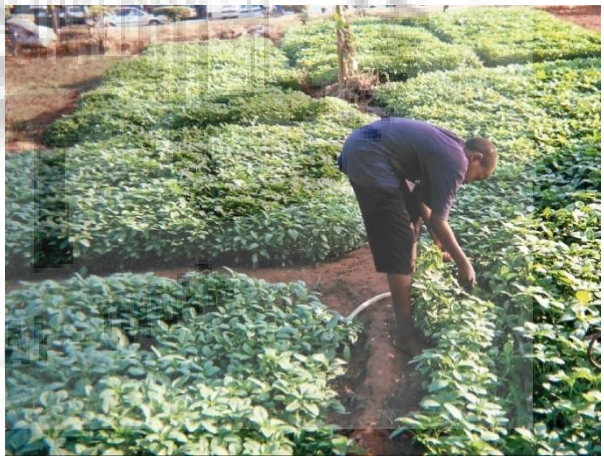
Unlike other large international cities, Paris has a lack of green space. Paris' dense infrastructure network, built largely of concrete and asphalt, causes a significant urban heat island effect in which city temperatures are noticeably higher than those in nearby rural areas. This trend is exacerbated by climate change, and to help reverse its effects, the city has instituted a range of greening initiatives that will make the city's infrastructure more permeable and absorbent and improve air quality.

To alleviate rising temperatures, Paris is greening its grey infrastructure, planting trees, and creating rooftop gardens all over the city in order to adapt to climate change and create a more pleasant living environment. In recent years, Paris has added nearly 70 hectares of green infrastructure and rooftop gardens in order to reduce the urban heat island effect. Going forward, as a law, vegetation must be planted on all new buildings, and soon the city will build 100 additional hectares of green roofs – one-third of which will be used for agriculture.

Samples of green roofs in Paris

i) "License to Green"-Permit to plant on vacant and undeveloped lands

To get citizens on board with the initiatives, the city issued a "license to green" to all Parisians, encouraging them to plant more trees and gardens on vacant pieces of land – anything from a small strip of grass on a sidewalk to a full-fledged community garden.



In Paris, citizens, by their "License to Green", are encouraged to farm on vacant lands

Essentially, the programme is a license for citizens to 'vegetate as much as you want'. The licenses, issued by the city, mean Parisian 'citizen-gardeners' are permitted to vegetate the capital in various ways. Whether this take the form of planting fruit trees, planting on walls, in the soil at

the feet of trees, posts or boxes, it doesn't matter. Thanks to this programme, every Parisian can become a gardener for a local, otherwise barren, site of their choice.

The idea is that by installing window boxes to grow tomatoes, or by using bare earth by a tree trunk to grow flowers, or by planting a climbing plant on a wall, people can combine their efforts to green the whole city. The city also provides gardeners with seed and soil for their project. If people need advice or want to learn about gardening, they can go to a 'Gardening House' where professional gardeners are available to help. In addition, meetings are organised to talk about projects, innovative ideas and sources of finance.

ii) Rooftop Farms-Bringing agriculture to the city

In the future, the world population is expected to steadily increase, and we will face the challenge of food shortages. In such a case, urban agriculture and vertical cultivation may be useful.

In a rooftop farm, vertical farming is adopted, in which crops are grown efficiently in a limited space by stacking up cultivation spaces vertically with respect to the ground, unlike conventional farms that spread horizontally. Thanks to vertical cultivation, a rooftop farm requires only 10% of the water needed in a traditional agricultural environment.

The world's largest urban farm opens on the rooftop of Porte de Versailles, which is used as a venue for international events and is about 15 minutes from the Eiffel Tower. The farm has an area about the size of 14,000 square meters, where more than 30 types of plants can be grown. About 1,000kg of fruits and vegetables will be harvested daily during the high season.

The world's largest rooftop garden in Paris will soon be on the roof of Porte de Versailles

The goal is to make the farm a globally-recognised model for sustainable production. The farm will also offer a range of services related to urban agriculture, including educational tours, team-

building workshops and special events. Last but not least, there will be the opportunity for local residents to lease small vegetable plots of their own – in specially-devised wooden crates – helping to reconnect city-dwellers with their food source.

iii) Following are the intended benefits of the Paris Initiatives:

1. **Environmental Benefits**: Increased vegetation absorbs more CO2 and improves air quality.

2. **Social Benefits**: 80% of Parisians support the initiatives to create more green spaces in the city, which will lead to a more pleasant living environment

3. **Health Benefits**: Fifteen thousand people died in France during a heat wave in 2003. To prevent such disasters from becoming more common, Paris is protecting its citizens –particularly the elderly and those in ill health – from excessive heat.

CHAPTER 8: CASE STUDY 2- INDUSTRIALIZATION: EFFECTS OF INDUSTRIALIZATION ON HUMANS AND LACK OF SPACE FOR INDUSTRIAL DEVELOPMENT IN MUMBAI

8.1 INTRODUCTION

In the scope of United Nations 2030 Agenda, industrial development plays a vital role in the economic growth as well as human development in the countries across the world. A major consideration taken in an account of Eco-system, Global warming while proposing in UN. Industrial development is necessary for the growing and building of industries for countries growth. When an area or economy is industrialized it experiences an increased standard of living, job growth, and more productivity as it sustains growth. As productivity in an area increases, there is so much more opportunity.

8.2 BENEFITS OF INDUSTRIAL ESTATES/PARKS

1.Economies of scale: Units located in an industrial estate can adopt centralized buying and selling. The requirement of all the members for raw materials and components can be pooled together and bulk purchases made. Such bulk purchases would be eligible for quantity discounts resulting in lower costs. Similarly, in the case of sales, the produce of members can be pooled together and sold. This would reduce selling costs to a great extent. This kind of centralized buying and selling would enable member units to enjoy scale economies.

2. **Economies of Agglomeration**: Agglomeration refers to the benefit of reduced production costs because of concentration of industries. The benefits from agglomeration are; availability of skilled labor, presence of repair, maintenance and service facilities, availability of components, presence of financial institutions.

3. Benefits of inter-relatedness: The finished product of one unit might be the raw material for another unit. Since the units are located close by, it results in savings in transportation costs for the purchaser and assured market and reduced selling cost for the seller.

4. Low investment: Since the government provides land for setting up industrial estates at affordable costs, the initial investment is less. Industrialists can acquire assets on hire-purchase or on lease and can benefit from higher output.

5. Availability of infrastructure: The infrastructural facilities such as electricity, water, roads, telecom etc., are readily available in industrial estates.

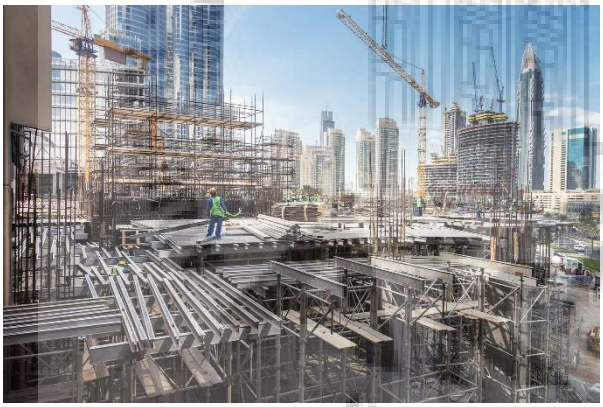
6. Increased employment opportunities: Industrial estates create more employment opportunities and increase the mobility of labor. Since many of the units are labor intensive, there are opportunities for both skilled and unskilled workers.

7. Development of backward areas: Industrial estates provide employment to the local youth. With their development a host of facilities such as banks, post offices, insurance companies, housing, schools, health care facilities come up. This results in the development of backward areas and balanced regional development.

8.3 EFFECTS OF INDUSTRIAL DEVELOPMENT ON CITIES

8.3.1 Positive Effects of Industrialization

1. Higher Standard of Living – A percentage of the population saw a higher standard of living and more disposable income.
2. More jobs – The working class found it easier to find jobs than in years prior due to factories needing so many different workers.
3. More affordable products – Mass production of products in factories meant more products available as well as less expensive, or more affordable products.
4. Development of Cities – One of the most long-lasting effects of industrialization is the increase in cities. Gone were the days where people lived in small cities or towns or on farms.



Industrial growth of the cities

8.3.2 Negative Effects of Industrialization

1. Child labour - Factory owners turn to unskilled children to work in their factories. It is mostly seen in under developed or developing countries. Children were easier to control and would work at a fraction of the wage their adult counterparts would.
2. Wage slavery – Workers were subjected to wages that were less than fair. Unfortunately, due to the need for work, they became slaves to both their jobs and the minimal wages they earned.
3. Slums – Neighbourhoods for the working class were less than ideal. The working class lived in overcrowded areas that were dirty and typically filled with pollution.
4. Terrible working conditions – At the start of the industrialization workers were subject to horrible if not dangerous working conditions. The working class worked as much as six days a week and 8 to 14 hours was a very common shift per day. There were safety hazards including excessive heat especially for ironworkers. Accidents were a common occurrence. Equipment and machinery had dangerous parts exposed, contributing to the number of injuries.

Child labour

Slums and living condition nearby areas of industries

Working condition of labours in industries

8.4 INDUSTRIAL POLLUTION

Industries and factories give off various pollutant in the environment including the land, air, and waters. It is estimated that about 50% of all pollution is as a result of industrial and manufacturing activities. It only displays how industries and factories are responsible for giving off toxic and dangerous materials into the environment. Illnesses, loss of life, and destruction of the ecosystem are some of the pollution outcomes that take years to manifest. Even so, there are a wide range of industrial pollution effects along with their serious consequences.

Different industrial activities, whether it is the extraction of raw material, processing, manufacturing, or waste disposal, leads to environmental degradation. Industrial pollution was started in contrast with the industrial revolution. Industrialization is one of the most significant achievements of us, simultaneously industrial pollution has been proved as the biggest curse not only for us but for the entire biodiversity of the planet.

Industrial Pollution

8.5 EFFECTS OF INDUSTRIAL SOLUTION

8.5.1 Global Warming

- Global warming is one of the most serious outcomes of industrial pollution, witnessed on the account of the steady rise of industrial activities. Industries release into the atmosphere a variety of greenhouse gases including carbon dioxide (CO2) and methane (CH4).
- Global warming has many several severe effects on human health and that of environment. Rise in water levels, melting of glaciers and extinction of polar species. Tsunamis, flooding, and hurricanes are some of the dire effects of global warming. Furthermore, global warming has threatened human survival and presented health risks such as the increased incidences of diseases like cholera, plague, Lyme disease and so on.

Global warming

8.5.2 Water pollution

- Pollutants and unwanted materials discharged from the industries have widespread implications, and one of the unpleasant effects is on water bodies. Industries demand lots of water for efficient production such as cooling, cleaning, and treatment and as such, the water drawn from the water sources is never the same after use. Inappropriate contamination of used water and the discharge of different industrial waste water into water sources often result in water pollution.
- In most cases, the water is contaminated with dangerous chemicals, radioactive materials, heavy metals or organic sludge. For this reason, dumping of the wastewater directly into

waterways or oceans negatively impacts on marine life, humans, and the environment on various aspects.

Industrial Water pollution

8.5.3 Air pollution

- By the increasing in number of factories and manufacturing processes, both large and small scale, gaseous emissions have continued to compound. This makes industrial pollution one of the main causes of air pollution. The release from industries, emission of contaminants gaseous like sulfur, carbon dioxide (CO_2), oxides of nitrogen, methane, and so on
- These gases spreads all over the atmosphere and results of several illness and environmental hazard. Formation of acid rains, the presence of smog, and heightened incidences of respiratory disorders among humans are some of the implications of air pollution.

8.5.4 Soil pollution

- Soil pollution occurs when the soil loses its fertility and structure owing to diverse natural and artificial phenomenon. Industrial soil pollution occurs due to disposal of industrial wastes into landfills is among the artificial aspects. Industrial wastes have in them varied amounts of toxic materials and chemicals such that when deposited in landfills, it accumulates in the top soil thereby depreciating the fertility and biological activity of the soil due to soil poisoning.
- Such implications eventually contribute to ecological imbalances thus creating problems in crop productivity. Apart from that, the chemicals and toxic materials in poisoned soils accumulate in plants grown in such areas causing health problems to those who consume such crops.

8.5.5 Effects on human health

- The world Health Organization (WHO) revealed that outdoor air pollution accounts for about 2% of all lung and heart diseases. WHO also underscores, around 5% of all lung cancers and 1% of all chest infections are implications of outdoor air pollution.
- For instance, one of the worst industrial disasters of all times that took place in Bhopal, India, in 1784 claimed the lives of more than 8,000 people and the effects were still being felt more than two decades later. This means, industrial air pollution may not manifest immediately but takes several years.
- Industrial toxic and chemical wastes that are disposed into water bodies or landfills are also responsible for cancers and human cell poisoning. For instance, exposure to inorganic arsenic causes tumors to form. Above all, industrial pollutants are responsible for thousands of illnesses and premature deaths across the globe.

8.5.6 Wildlife extinction

- The tendency of industrial and manufacturing processes that constantly demands production resources and repeated exploitation of raw materials has cumulatively led to the destruction of forests and the natural habitats that support wildlife.
- Acts such as mining, deforestation, and utilization of water resources for industrial production have destroyed natural habitats and forced organisms to move further into the wild, exposing them to predators and intolerable living conditions.
- Consequently, some wildlife species have faced extinction while several others remain highly endangered. Industrial wastes, chemicals, emissions, or accidental leaks, fires, oil spills and so on have also been prime contributors to wildlife extinction.
- For example, the BP oil accidental spill in 2012 claimed thousands of marine life, and some of them were among the rarest species on earth. Even after some time had passed, marine animals continued to die.

Effects of industrial pollution on wildlife

8.6 CAUSES OF INDUSTRIAL POLLUTION

8.6.1 Industrial growth without proper planning

Unplanned industrial growth is one of the major causes of industrial pollution. In most of the industrial areas, the factories have ignored the standard rules and regulations for industrial setup. As a result, these industries have end-up polluting the air, water, and soil by releasing contaminants.

8.6.2 Use of old technologies

Most of the factories and industries are relying on old technologies as updating advanced technologies is expensive as compared to out dated ones. The old technologies generate a massive amount of toxins and waste than advanced technologies, hence polluting the environment.

8.6.3 Leaching of natural resources

Many factories need a considerable amount of raw material to produce the end-product. The raw material can be taken out from the Earth's surface by the process called extraction. There are risk factors involved with the extraction of raw material when spilled on the Earth, causing soil pollution.

8.6.4 Improper waste disposal:

Waste disposal through correct ways is crucial for the conservation of the environment, whether it is industrial waste or the waste we produce at our home. Improper waste disposal from factories is majorly responsible for industrial pollution that causes poor air quality and various health hazards.

8.6.5 Emission of hazardous chemicals

The hazardous chemicals used by the factories for manufacturing or other processing can be termed as the root cause of industrial pollution.When these chemicals are released in the environment leads to different forms of pollution like air pollution, water pollution, and land pollution. Industries pollution is responsible for producing more than 25 million tonnes of toxic chemicals through industrial activities.

8.7 CASE STUDY: INDUSTRIAL DEVELOPMENT AND LACK OF SPACE FOR INDUSTRIALIZATION IN MUMBAI

8.7.1 Introduction

It is well recognized that industries play a very important role in the economic development of nations, regions as well as cities. In the modern era, the organization of industry is not based on the organization of human skills alone but also based on several factors that affect their operations like technology, capital, access, knowledge, vicinity to logistics/market, competition, etc. Therefore, industries are becoming very agile in their manufacturing operations as well as their supply/distributional chains. However, industrial operations are inevitably exposed to a variety of risks arising out of the market conditions, technological changes and disappearance of the advantages over a period of time. economic and financial factors as well as government policy play an important role in the economic and financial factors as well as government policy play an important role in the thriving of industries as well as their vanishing. The abandoning of industrial operations due to a reduction in the scale of operations or complete shifting of

operations results in throwing up of huge amount of land with potential for development because human settlements and infrastructure that come up around them in the due course of time.

It may appear as though land use changes and development take place automatically in a city and new economic activities find place immediately. But this requires changes to be approved by the city planning authority and the city development plan has to make provisions for the same in order that such change takes place. In several cities, this does not happen with mere application for land use change and development on it; the whole process is ridden with great complexities and huge uncertainty gets built in the course of time. Mumbai, one of the oldest and historic Indian cities, presents an experience of the same. This paper first traces the industrial location policy changes in the metropolitan region of Mumbai, which is an important aspect of the industrial development in Mumbai. Subsequently, it analyses Mumbai's experience of its inability to develop the old textile mill lands and also spare parts of machine.

8.7.2 History and Background

Mumbai is a major metropolitan city of India with a gigantic population of over 20 million in the urban agglomeration. It is an important city whereby the private corporate sector is strongly present and is considered as the economic powerhouse of the country even in the modern era after liberalization. Mumbai has been the powerhouse of the India since the British rule. Industrial activity was the backbone of its economy and that of the whole state of Maharashtra. Industrial activity led by the different industries has spread across the city with several large and medium scale industries establishing themselves in the city and its neighbouring areas in the post-independence era. The development plans and industrial policies of the State made provisions for the same through earmarking industrial zones for manufacturing, trade and logistics operations. While Bombay has shown how to build the enormous potential in industrial production, the city also faced difficulties with maintaining the growth and quickly slipping into de-industrialization path that was also the focus of the state government later. Concentration of industries and industrialization has also begun to show negative effects like pollution and congestion, and the demand was coming for moving the industry to the outer areas.

Mumbai city development plan was first founded in the erstwhile Bombay Plan of Tatas but the government has formally started it with the enactment of Maharashtra Town and Country Planning Act, 1766. The Mumbai Metropolitan Region Plan (1770-1771) was the first plan prepared under the act which came into effect from 16 August 1773. This plan indicated the policy to be followed for the location of industries in the region and provided for review of this policy. The revised regional plan 1776-2011 has taken forward the concept of 'decongestion of population' of island city further to identify the major nodes in the suburbs that could act as potential CBDs, resulting in lesser and lesser population commuting upto the Nariman Point CBD. Yet, it has completely overlooked the potential industrial decongestion in the form of textile mills relocation (and land release), and it rather confined to light and medium engineering industries.

8.7.3 Industrial Location Policy

Industrial Location Policy was first laid down through the Circular Memorandum of Industries, Energy and Labour Department No. IDM 874/ 733782/Planning dated 26 December 1774. The industrial location policy has therefore been in existence for 24 years until the liberalization policy announced by the Government of India, which was quickly followed by Maharashtra state. Government of Maharashtra formulated industrial location policy in 1773 and a comprehensive industrial policy for Mumbai Metropolitan Region came into force vide Government Resolution No. ILE 872/348/IND2 dated 4 May 1773.

The basic approach of the new industrial location policy has been to address the issues of declining employment in Mumbai and its suburbs, need for modernization, diversification and expansion of the existing industries without sacrificing the objectives of decongestion and ensuring pollution free environment. The need for decongestion of the city – both in terms of economic activity i.e industry, as well as human population was actually founded in the First city development plan (or Master Plan) of Mumbai for the period 1760- 1785. Both industrial policy as well as regional development plan provided for industrial development through zoning, which has been the prevalent tool for a very long time. In purpose of e of the industrial location policy

and planning, the Mumbai Metropolitan Region (MMR) was divided into 3 zones, which are as follows

- Zone I: consisting of Greater Mumbai and areas of Thane Municipal Corporation, and Mira Bhayander Municipal Council.
- Zone II: consisting of areas of Kalyan and Navi Mumbai Municipal corporations; Ulhasnagar, Ambernath, Kulgain-Badlapur Municipal Councils; Bhiwandi and Uran sub-regions and Vasai-Virar sub-regions as per Notification No. TPS 1287/2753/CR-228-81/UD-12, dated 14th May, 1770. (Schedule IV).
- Zone III: consisting of other areas within MMR, excluding from zone I and II above.

8.7.4 Tabular wise industrial location restrictions in the MMR:

Item	Zone I	Zone II
1. New unit, substitute unit for one that has closed down or relocation of unit from elsewhere.	a) will be allowed freely for schedule I industry. b) Will be allowed for Schedule I-A Industries in Thane Municipal Corporation area and Mira-Bhayander Municipal Council area subject to conditions mentioned in Para 7 of this GR. c) will not be allowed for others.	a) Other than units of Schedule II industries will be freely allowed. b) Schedule II industries will be allowed only in MIDC area. In other areas, they may be allowed only after approval of Committee mentioned under para 7 of this GR. c) In Uran sub-region a defined in Schedule III no new/substitute unit will be allowed.
2.Expansion, modernisation or diversification of an existing unit	a) will be allowed for Schedule I industries.	a) Expansion etc. Other than Schedule II industries will be allowed.

	b) will be allowed for Schedule IA industries in Thane Municipal Corporation Area and Mira-Bhayander Municipal Council Area, subject to the conditions in para 7 of this GR c) Will be allowed for Schedule II industries provided the overall source pollution decreases and does not require additional power and additional built up area for manufacturing purpose. d) Not covered under Schedule I, IA and II will be allowed upto permissible FSI, provided additional power is limited to 25 percent of authorised connected load on 4.5.73.	b) Expansion etc. of schedule II industrial will be allowed only in MIDC areas. In other areas, it may be allowed only after approval of committee mentioned under Para 7 of this G.R.
3.Proposed industrial estate construction on an open plot	a) will be allowed for housing schedule I industries only. b) Will be allowed for schedule IA industries in Thane Municipal Corporation Area and Mira Bhayander Municipal Council Area subject to condition in Para 7 of this GR.	a) Construction will be allowed for housing other than Schedule II industry b) In MIDC areas, construction will be allowed even for housing schedule II industry.

	c) Will not be allowed for housing other than (a) and (b) above.	
4. Expansion of approved industrial estates (having final NOC)/division of gala of structure.	a) Will be allowed to house only Schedule I industries and Schedule IA industries in Thane Municipal Corporation Area and Mira-Bhayander Municipal Council Area subject to condition in Para 7 of this G.R	a) will be allowed for housing other than Schedule II industry. b) In MIDC areas, expansion/division will be allowed even for housing Schedule II industry.

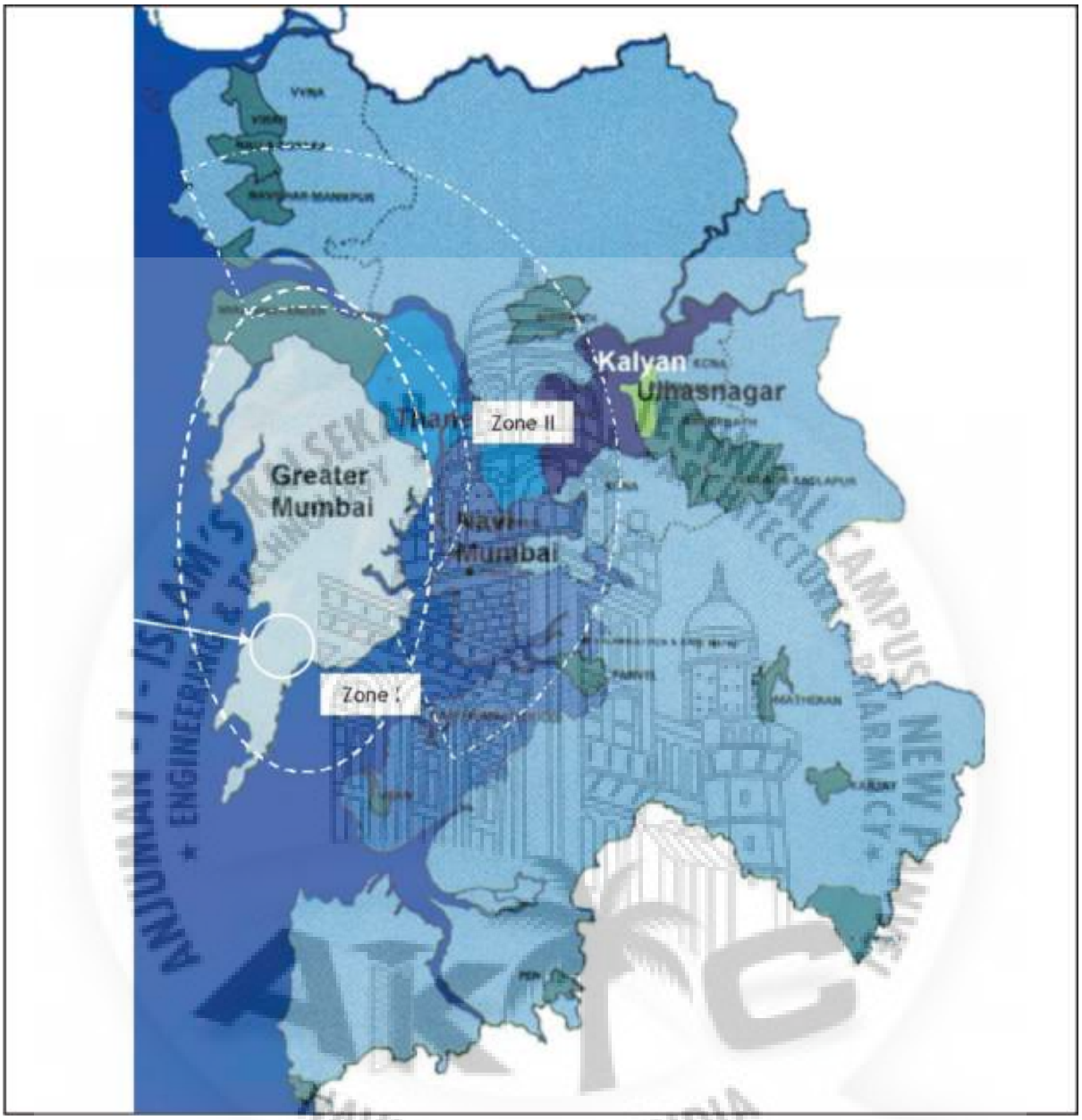


Fig. 1 Industrial Location Zoning in Mumbai Metropolitan Region (source MMRDA)

8.7.5 Andheri West, Mumbai industrial area

Being commercial and residential developed city, Mumbai has few major industrial area. In which Andheri's Chakala industrial area under MIDC, is well known for city's industrial sector region. State's major economy distribution from industrial sector comes from this region only.

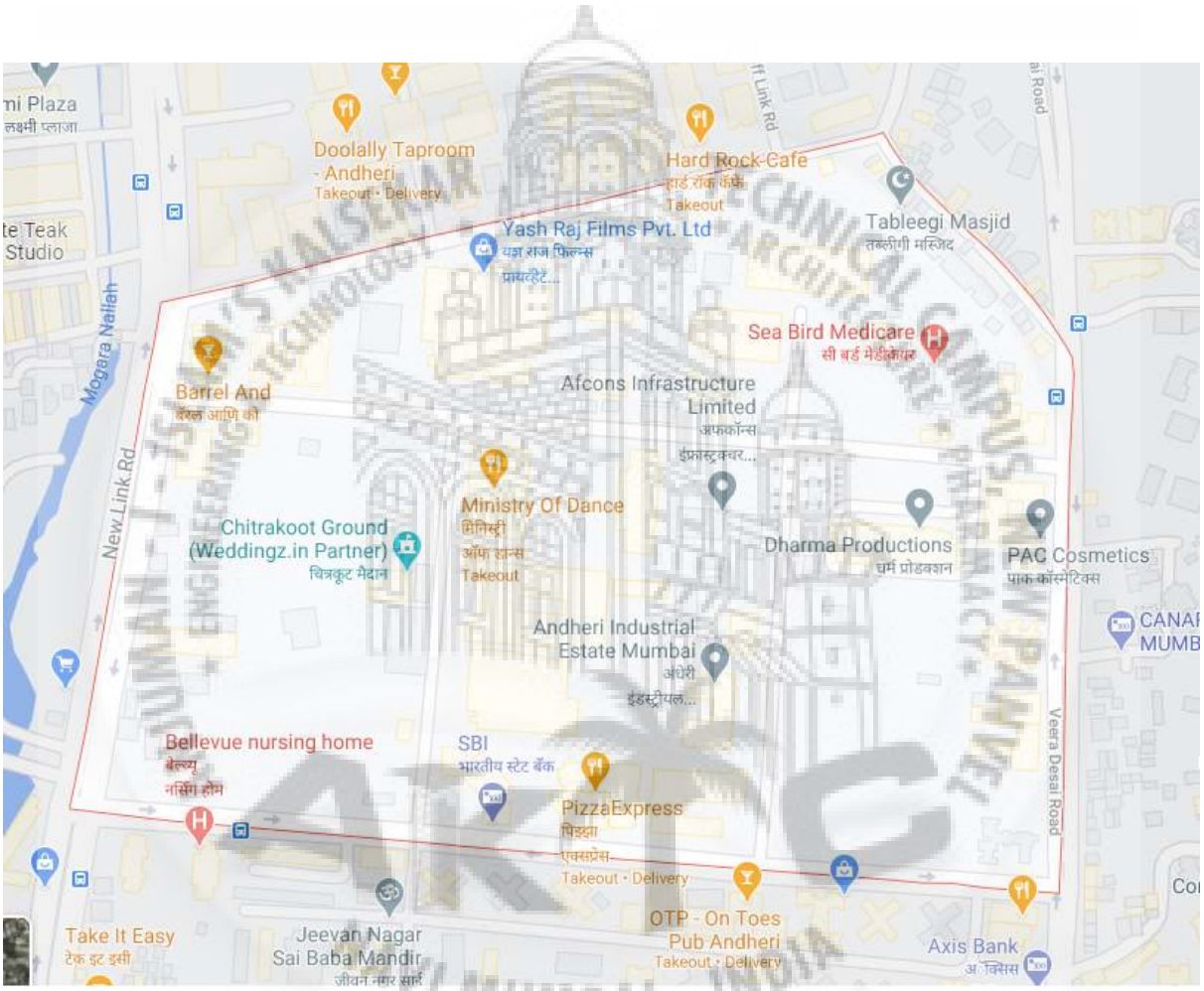


Fig. 2 Andheri Industrial Estate, Mumbai (source Google Map)

Mumbai's MIDC area comes under IT and ITeS, Gems and Jewellery, Logistics and Pharma / Chemical. Major companies like Godjrej, HCL, Voltas, TATA , Asian paints, JSW are located here and have major contribution towards the industrial development of the city.

Others MIDC's industrial area located in Navi Mumbai. Taloja has major contribution in Navi Mumbai sector's industrial area which is also come under MIDC. All MIDC area development is passed by Maharashtra Pollution Control board.

8.7.6 Conclusion

It has been argued that the release of industrial land has created a positive environment for development and reduced uncertainty in property markets, both of which led to improved performance of local markets in the border of CBD and suburbs. Industrial location policy plays a vital role in regional development in terms of industrial development of the city. Updated policy of same promotes modernization, diversification and expansion of the existing industries without sacrificing the objectives of decongestion and ensuring pollution free environment. Based on this policy the whole region of Mumbai is divided into three zone. This zone divides the Mumbai and other area in different industrial sector.

In Mumbai, only Andheri (West) has industrial area which is come under MIDC. It contributes major part in India's GDP. MIDC's another hub is located in Navi Mumbai.

Industrial development and industrial area in Mumbai city are not so widely spread because of lack of space. Navi Mumbai has large space for industrial development so Navi Mumbai is widely spread in this sector.

CHAPTER 9: CASE STUDY 3- CLIMATE CHANGE: EFFECT OF CLIMATE CHANGES AND REHABILITION OF A MICRO-CENTRAL HYDROELECTRIC INSTALLATION-NUEVA ALIANZA

9.1 Introduction

What Is Climate Change?

You have probably heard the terms climate change and global warming used interchangeably. That's because both describe changes in earth's climate. While global warming focuses on the rising average temperature of the planet, climate change usually refers to the shifts in things like precipitation, wind patterns, and temperatures over a given period. Measured changes in climate could last a few years, decades, or even millions of years.

Climate change has occurred for as long as the earth has existed. It happens anytime earth's climate patterns change and remain in place for a measurable amount of time. This has notably manifested itself in natural cycles of cooling and warming. Before human causes started to shift the global climate, five main factors interacted with one another as climate changes occurred. These five factors include:

1. Atmosphere (air)
2. Biosphere (living things)
3. Cryosphere (ice and permafrost)
4. Hydrosphere (water)
5. Lithosphere (earth's crust and upper mantle)

Perspectives from India

Climate change is no more an environmental concern. It has emerged as the biggest developmental challenge for the planet. To dialogue from the perspective of the poor is one of UNDP's contributions to overall development process. This collection of articles captures and disseminates perspectives on climate change from the Indian context. Starting from an argument on a new climate deal to highlighting the importance of the small-scale industrial sector within the climate change debates, some of India's best known environmentalists, economists and policy makers have put forward their concerns and convictions in this collection. We hope that this collection will ferment a debate that links climate change to overall development and put a human face to the overall climate change.

What Are the Causes of Climate Change?

The American Association for the Advancement of Science has stated, "The scientific evidence is clear:global climate change caused by human activities is occurring now, and it is a growing threat to society."

9.2 Causes of climate change

Greenhouse Gases

Greenhouse gases play a vital role in the earth's climate cycles. As the planet gets hit with the sun's rays, some of the energy is absorbed, and the rest of that energy and heat gets reflected into space. Greenhouse gases in the atmosphere trap the reflected energy, redirecting it back down to the earth and eventually contributing to global warming. Various gases play this role, including:

Water vapour

Carbon dioxide (CO_2)

Methane

Nitrous oxide

Chlorofluorocarbons (CFCs)

Solar Activity

Solar activity, does play a role in the earth's climate. While the sun does go through natural cycles, increasing and decreasing the amount of energy that it emits to the earth, it is unlikely that solar activity is a major contributor to global warming or climate change. Since scientists began to measure the sun's energy hitting our atmosphere, there has not been a measurable upward trend.

Agriculture

There are many significant ways in which agriculture impacts climate change. From deforestation in places like the Amazon to the transportation and livestock that it takes to support agricultural efforts around the world, agriculture is responsible for a significant portion of the world's greenhouse gas emissions. However, agriculture is also an area that is making tremendous strides to become more sustainable. As productivity increases, less carbon is being emitted to produce more food. Agriculture also has the potential to act as a carbon sink, and could eventually absorb nearly the same amount of CO2 it emits.

Deforestation

Deforestation and climate change often go hand in hand. Not only does climate change increase deforestation by way of wildfires and other extreme weather, but deforestation is also a major contributor to global warming. According to the Earth Day Network, deforestation is the second leading contributor to global greenhouse gasses. [8] Many people and organizations fighting against climate change point to reducing deforestation as one of, if not the most, important issues that must be addressed to slow or prevent climate change.

Human Activity

According to the Environmental Protection Agency, the most significant contributor to climate change in the United States is the burning of fossil fuels for electricity, heat, and transportation. Of these factors, transportation in the form of cars, trucks, ships, trains, and planes emits the largest percentage of CO2– speeding up global warming and remaining a significant cause of climate change.

Livestock

While interconnected to many of the agricultural and deforestation issues we have already touched on, livestock in the form of cattle, sheep, pigs, and poultry play a significant role in

climate change. According to one study, “Livestock and Climate Change, ”livestock around the world is responsible for 51% of annual global greenhouse gas emissions.

9.3 Immediate Effects of Climate Change

From melting glaciers to more extreme weather patterns, people everywhere are beginning to take notice of the real impacts of climate change. While some nations around the world are taking action with initiatives such as the Paris Climate Agreement, others are continuing business as usual–pumping millions of tons of carbon into the atmosphere year after year. While the long-term consequences are still to be seen, for now, climate change continues to cause extreme weather as well as safety and economic challenges on a global scale.

Extreme Weather

Changes to weather are perhaps the most noticeable effect of climate change for the average person. One reason for this is the financial impact severe weather events can have. So far in the U.S. during 2019, there have been six climate disasters, most costing more than $1 billion. According to the National Climate Assessment, extreme weather events will continue to increase in frequency and intensity as climate change continues to happen. Extreme weather influenced by climate change includes:

Stronger storms & hurricanes
Heatwaves
Wildfires
More flooding
Heavier droughts

Long Term Impact of Climate Change

The long-term impact of climate change could be absolutely devastating to the planet and everyone and everything living on it. If the world continues on its current trajectory, then we will likely continue to see increasing effects on everyday life.

Health

There are many ways in which climate change could impact people's health. Depending on age, location, and economic status, climate change is already affecting the health of many and has the potential to impact millions more.

Negative Impact in Ecosystems

Ecosystems are interconnected webs of living organisms that help support all kinds of plant and biological life. Climate change is already changing seasonal weather patterns and disrupting food distribution for plants and animals throughout the world, potentially causing mass extinction events. Some studies estimate that nearly 30% of plant and animal species are at risk of extinction if global temperatures continue to rise.

Water & Food Resources

Climate change could have a significant impact on food and water supplies. Severe weather and increased temperatures will continue to limit crop productivity and increase the demand for water. With food demand expected to increase by nearly 70% by 2050, the problem will likely only get worse.

Sea Levels Rising

Rising sea levels could have far-reaching effects on coastal cities and habitats. Increasing ocean temperatures and melting ice sheets have steadily contributed to the rise of sea levels on a global scale. At current rates the National Oceanic and Atmospheric Administration estimate sea levels

to rise by at least 8 inches by 2100, potentially causing increased flooding and decrease in ocean and wetland habitats.

Shrinking Ice Sheets

While contributing to rising sea levels, shrinking ice sheets present their own set of unique problems, including increased global temperatures and greenhouse gas emissions. Climate change has driven summer melt of the ice sheets covering Greenland and Antarctica to increase by nearly 30% since 1979.

Ocean Acidification

The ocean is one of the main ways in which CO2 gets absorbed. While at first glance that may sound like a net positive, the increasingly human-caused CO2 is pushing the world's oceans to their limits and causing increased acidity. As pH levels in the ocean decrease, shellfish have difficulty reproducing, and much of the oceans 'food cycle becomes disrupted.

9.4 Solutions for Climate Change

While the effects of climate change can seem bleak, there is still hope. By taking immediate action to curb climate change, we may never see the worst consequences. Likewise, as the world adopts cleaner, more sustainable energy solutions, there may be millions of new jobs created and billions of dollars of economic benefits. Below are some practical ways you can battle climate change, including: Renewable Energy Certificate for your home power needs Make your home energy efficient Buy carbon offsets, Adopt a plant-based diet, Reduce food waste, Recycle,,Stop using fossil fuels and Stop deforestation.

9.5 Case Study: Rehabilitation of a micro-central hydroelectric installation, Nueva Alianza, Guatemala

2008 Wisions Award Winner
(Wuppertal Institute for Climate, Environment and Energy; www.wisions.net)

Project Data

Name of grantee: Syndicate of Independent Workers of Nueva Alianza, El Palmar (STIAP)
Start date: June 2005
Completion date: August 2006
SGP/CWI grant amount: US$21,074

Background

The community of Nueva Alianza is an organic coffee and macadamia plantation owned and operated by a cooperative of forty Guatemalan families in the western Quetzaltenango District. These families formed the Sindicato de Trabajadores Independientes (STIAP, syndicate of independent workers) and purchased the estate in 2004 after the previous landlord abandoned it because of debt.

There are many challenges in operating a plantation in this region of Guatemala. Poverty rates are high and many areas are isolated from the main electricity grid, creating a heavy reliance on diesel fuel for power generation. There are also two main seasons in the region: the rainy season (May - mid-November) and the dry season (December - May). The region may experience very little rainfall for months on end during the dry season, and periodic droughts result in significant agricultural, energy, and social impacts. Guatemala's location between the Caribbean Sea and Pacific Ocean also makes it a target for hurricanes. Hurricane Stan, in 2005, was especially damaging for the local area as rains washed out bridges and roads, cutting the region off from the rest of the country and caused water and diesel shortages.

Project Activities

To promote water development and help mitigate and adapt to climate change, CWI provided funds to assist STIAP to rehabilitate some idle structures that had been abandoned during the landlord's days. This incorporated the rehabilitation of the old micro hydropower structures, a coffee plant with operative machines, empty houses, electrical generators and a diesel engine. The project also comprised the construction of new civil works, the installation of transmission and distribution lines, the building of 40 domestic electrical and water connections and an additional one for industrial use.

The rehabilitated hydropower plant has an installed capacity of 10kW. It's designed to run two electrical generators, each with a capacity of 8kW, which increases the total power to 16kW. In the winter, when heavy rain swells the river, both generators are used. In the dryer summer season, Nueva Alianza produces biodiesel by recycling oils from nearby restaurants to run the electrical generators. A climate contingency plan, that halts energy production and diverts river flows, was also put in place to protect the plant whenever a hurricane threatens.

The project also included capacity building activities to foster women's involvement and community self-management. Women took the lead in organizing workshops on construction and maintenance of the facilities, as well as implementing conservation projects to protect the river's riparian zone.

Results and Lessons Learned

The project has allowed Nueva Alianza to generate non-polluting, renewable, and cheap hydropower, which supplies agro-industrial activities for the production of macadamia nuts and is also used for household consumption. It has also created dependable supplies of water to local families, and fostered the production of purified water that is bottled and sold in surrounding towns.

The benefits of the project were made especially clear during Hurricane Stan, in 2005. The community was not as affected as other local areas because they implemented their climate

contingency plan to save the hydropower facilities and macadamia crops17, and they were able to provide purified water to devastated communities around Retalhuleu18. In 2005, the community won the productivity award “a la Productive” from the government of Guatemala.

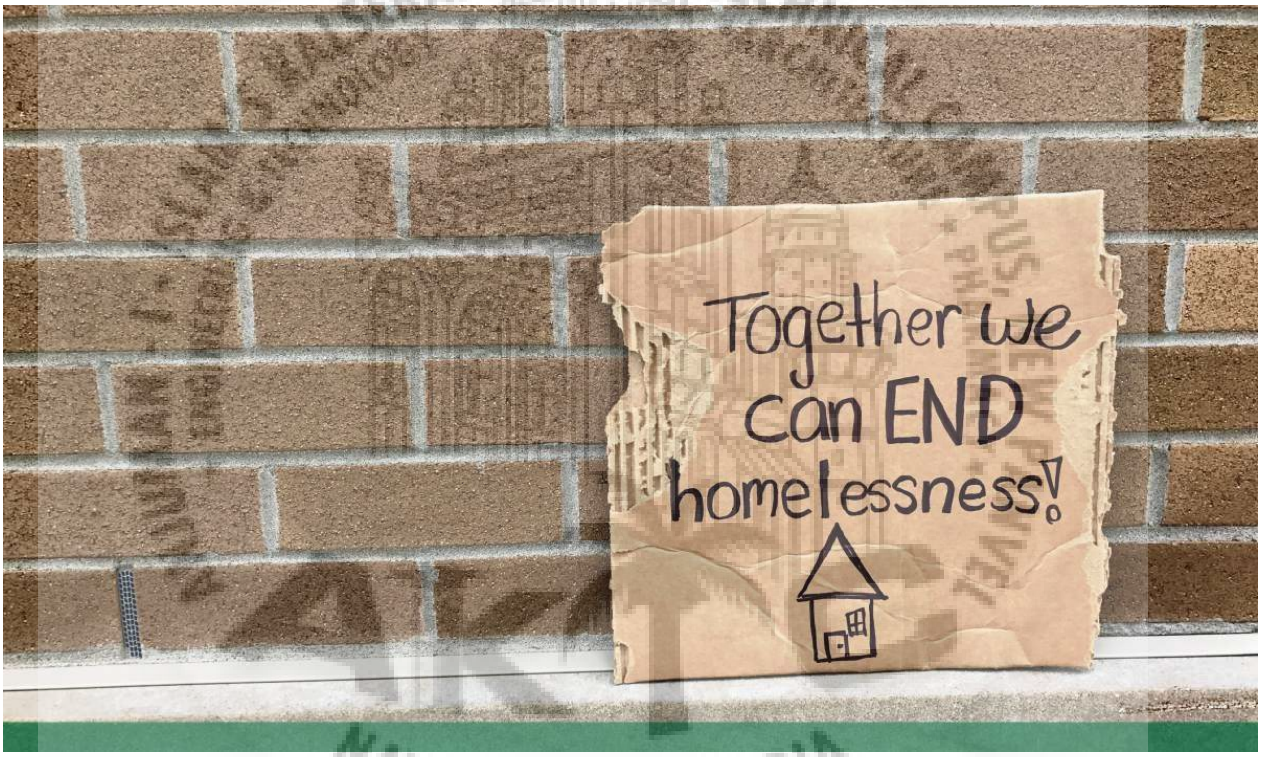
Climate Change Mitigation and Adaptation

Using hydropower as an energy source can reduce the amount of green-house gases that are generated in comparison to other traditional sources, which serves to mitigate climate change.

This project utilizes water for hydropower when it’s abundantly available (and protects local production when it’s excessive), and utilizes local waste products for biofuel to run generators during the dry season. These efforts which will help stabilize local energy, water, and agricultural production under variable climate conditions.

Implementing water and land management conservation activities also helps protect the local environmental resources, foster carbon sequestration, and creates more robust ecosystems that are more resilient to the effects of climate change. Similarly, stabilized agricultural production and diversification into other businesses increases local capacities of the local population to better deal with the uncertainties associated with climate change.

CHAPTER 10: CASE STUDY 4- A STUDY OF HOMELESSNESS AND PREVENTIVE MEASURES OF HOMELESSNESS ISSUE IN ILLAWARRA, NEW SOUTH WALES



10.1 Introduction

Life has a lot of good and bad affairs. However, people always look for the better. Herefore, they like just the nice affairs that help them to develop and ensure them a gracious life. On the other hand, there are bad affairs which make people unhappy when they see them or even just when they remember them, so they will feel uncomfortable. As a result, life will be more difficult for them. One of those affairs is homelessness. Homelessness exists in all countries and most communities in the world. Herefore, it is known that homelessness is the biggest social problem which the whole

world faces in the twenty-first century. That means that homelessness is an international issue that exists in a lot of societies and every locality people live in and some people in the world suffer from instability due to homelessness. Naturally, homelessness is not a fine phenomenon because unfortunately it is a proof that there is a defect in the societies that have it. Apparently, homelessness Defects' personal life for homeless people themselves and others. Therefore, it is very important to find a solution for this matter. To reach to a solution for any issue or problem, it needs a comprehensive study on it in all aspects, so as we get complete information about it. For example, we have to know, the causes which tend to it, the effect which consequent that issue, the issues which people suffer from them and the people themselves who Suffer from it. Then we will be able to choose the right solution for that phenomenon or issue. This applies to homeless people who we see every day. There are many causes and effects for homelessness. Also, homeless people have their own issues.

Who Are the Homeless?

the individuals and families experiencing homelessness While stereotypes are common in reference to families and individuals living in poverty and homelessness, studies show that they have varying needs and characteristics. For example, many families experiencing homelessness are headed by single mothers, and people of colour, particularly African American, are a group that is overrepresented. According to the Public Broadcasting System (2007), 41% of the homeless population are non-Hispanic Whites (compared to 76% of the general population), 40% are African Americans (compared to 11% of the general population), 11% are Hispanic (compared to 9% of the general population), and 8% are Native American (compared to 1% of the general population).Because homeless children often perform poorly in school, maintain a lower attendance rate, and have more long-term absences (Solutions for America, 2003), these

statistics are especially significant for African Americans, Hispanics, and Native Americans. I was curious to discover if African American, Hispanics, and Native American are under or over represented in the homeless population of this Midwestern city. I wondered if the majority of families consisted of children living with single fathers, two-parents, grandparents, or other family members. This study examined those details and revealed demographic patterns.

10.2 Defining Homelessness

The definition of homelessness is by no means simple to understand. Homelessness is not discriminatory of race, sex, age, disability or even previous social status. The people themselves are an enigma; difficult to understand in how they can continue to live with such hardship.

In fact, even if it were possible to count all of the homeless people, not everybody would agree that the correct definition of homelessness was used. However, a well accepted view of homelessness says that if a person falls into at least one of the following three categories they are considered to be homeless:

1.) No permanent place of residence.

2.) Residing in a shelter, a hotel with vouchers, or a location not intended for human living.

3.) Living in someone else's home without a regular arrangement.

Not only are the definitions varied throughout the globe, they also differ from region to region within the same country. Worcester has its own unique homeless demographic, different even from the demographic of Boston, which is in the same state and only 45 miles away.

Homelessness as a Problem

Imagine a world where food is a struggle to obtain, hygiene is a forgotten afterthought and safety is desperately hoped for. While this may sound like the backdrop for dystopian literature, it is instead the tragic reality for so many people. There are countless people in this world who live without a permanent shelter over their heads or enough money to purchase the basic essentials of life, such as food, hygienic materials or clothing. These people, regardless of circumstance, are collectively called the homeless. They come from all walks of life, with no restriction on race,

sex, age, colour or creed. While they all share the same name, no two situations are alike. For this reason, these people are classified in completely different ways.

When people in industrialized civilizations think of homelessness, they generally imagine third-world countries where poverty is rampant. While this is a valid example of homelessness, the problem exists in nearly every country of the world. The homeless are generally classified by experts into several groups; impoverished, seasonal homeless, mentally ill and handicapped. A homeless person may be attributed with one or several of these categories.

The impoverished are simply those without any, or at least very little, income. They are unable to change their economic situation on their own, either because of geographic location, lack of technical skills or by holding outstanding debts which cannot realistically be paid in full. Generally, the impoverished are thought of to exist in third-world countries only, but they are present even in the largest cities of the world.

The hidden homeless are those who are not physically without shelter, but do not have a permanent home. Most hidden homeless are working-class families who became unable to keep up with expenses and have moved in with family members. While the hidden homeless do have shelter, their families must now deal with cramp, and possibly dangerous, living conditions. The hidden homeless are considered an actual problem because those who are unable to rebound from their situation are sent into the streets when their families can no longer suffer the burden.

The seasonal homeless include those with seasonal employment, such as farming jobs, those affected by natural disasters and the occasional runaway. These men and women had homes and a sufficient living, but due to circumstances beyond their control, they have lost or were forced to give up their physical possessions. These individuals do not appear homeless, but do not actually possess homes of their own and are often forced to live in overcrowded living conditions, such as with extended family or friends. These people all rely on the welfare systems implemented by the government, and local aid groups, and as such cannot be omitted from consideration. The seasonal homeless generally are seen as able to recover from their situation when given immediate aid and time.

10.3 Problems faced by homeless people

Multiple degrees of vulnerability characterize their daily lives in consonance with the earlier discussion that homelessness is a multidimensional problem. Each day is a monumental challenge for the homeless people. On the streets, they are the victims of police brutality and rich people annoyance. In shelters, there are issues of accessibility, abuse and rigidity. In the night, women become highly vulnerable as anyone can brush his hand over their bodies.

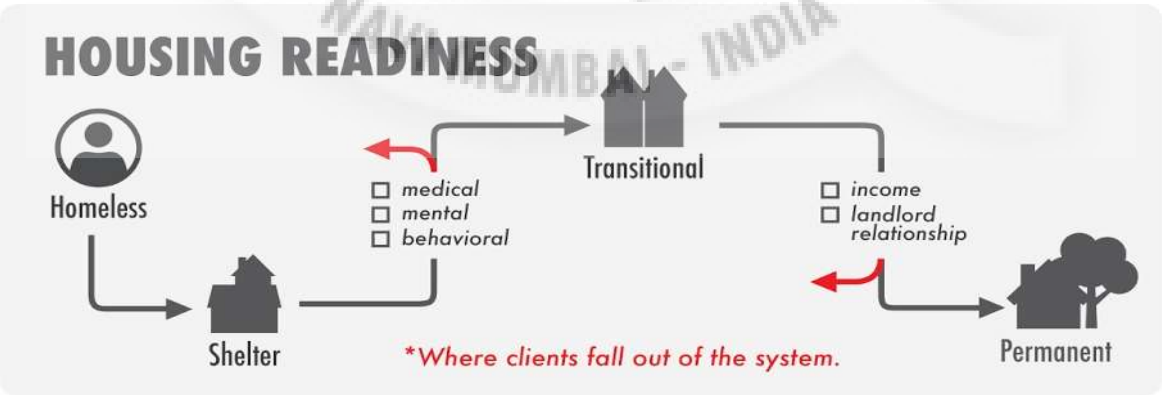
One of the major and degrading problems was the arrest and holding up of the homeless people under the provisions of Begging Act. The lack of identity cards and social support systems only compound the problem. The indifference of the people and the institutions only make their soul feeble.

10.4 The effects of homeless people

However, there are many effects of homelessness. He diseases are of main for these effects of homeless people. Most of them have health problems. Some of diseases which they have are intractable or permanent such as cancer. In addition, they are vulnerable to dangerous diseases such as hepatitis and sexually transmitted Infections. Also, some of them are non-chronic. They suffer from diseases because of several reasons. One of these reasons is that homeless have difficult\ accessing hospitals and health services (Hospital discharge of homeless people, 2012). Other reason is that they do not care about their personal hygiene. Where that, some of them are not taking a shower for a long period of time, maybe it reaches to consecutive three months. But, what about the reasons which made them do not bathe? Here are many reasons; one of them is that they do not have houses that mean there is no place to take a shower for them. In addition, lack of awareness is one of core reasons. Where that there is no one tells them that ablution is very significant for their health. So, most of them do not have knowledge about the importance ablution for their health. This is because the majority of them do not have families and friends which mean they do not have anyone help to know the health ailments which maybe happened because of lack of ablution. Also, most of governments in the world do not contact with them and show them the risk of not washing. In addition, homeless youth suffer from psychological symptoms such as depression, anxiety and behavioural disorders at high rates.

10.5 Resolving Homelessness

Once the issue of homelessness is recognized and clearly defined, actions must be put forth. Taking actions against homelessness, however, is much more complicated than attempting to understand it. With an enormous count of homeless people, with differing reasons as to why they are homeless, it is nearly impossible to strategize a single action which will make a lasting impact. With a wide variety of situations to take into consideration, minimizing homelessness is an endless battle. The only similarity every homeless person share is he or she does not have a home because they cannot financially afford it. Although the homeless population is proportionally smaller in comparison to the rest of the population, there is not nearly enough funding, private or government, to support all of the homeless. Therefore, one of the most affective steps which can be taken towards minimizing homelessness is providing more affordable housing. In order to do so, there must be federal spending for housing. The low income housing plan provides government funding, making living in a home more affordable for the poor and homeless. Over the years, cities and advocacy groups have tried to improve the overall conditions for the homeless. The system for doing so, however, is inherently flawed. Many homeless are driven away by the conditions and environments in shelters, so much they are willing to risk their lives out on the streets in the middle of winter, rather than stay in provided housing.



10.6 Case study: A women's domestic violence service: Supported Accommodation and Homelessness Shoalhaven, Illawarra, New South Wales

Supported Accommodation and Homelessness Services Shoalhaven Illawarra (SAHSSI) is a Specialist Homelessness Service formed when Wollongong and Warilla Women's Refuges merged in late 2014. The agency is targeted to single women and women with children who are at risk of, or experiencing, homelessness. SAHSSI operates two crisis accommodation support services that provide intensive case management support for six weeks to women (with or without children) who are subject to domestic violence or other life crises. Also, the agency operates 40 transitional properties in the Illawarra. Where appropriate, clients have transitional housing as an option. Another option is rapid rehousing into the private rental market for clients with low needs who can move quickly onto living independently. There is an early intervention outreach response for women in rental properties where losing their tenancy is an issue. Two additional programs provide support for female partners of domestic violence perpetrators; those who are attending the Corrective Services NSW Perpetrator Program funded by Corrective Services, and; the Partners in Recovery program which aims to better support people living with severe and persistent mental illness by providing a more coordinated system response to their mental health needs (SAHSSI 2016a, 2016b).

SAHSSI operates under a Management Committee made up of various community members from a diverse range of private and community-based sector representation within the Shoalhaven/Illawarra District.

SAHSSI receives Commonwealth and NSW government funding to deliver specialist homelessness services and other support programs, and a small amount of funding from other sources including fundraising. However, as outlined in Table 2 below, in the 2015 financial year, the majority of their income came from SHS funding from the NSW Department of Family and

Table 2: SAHSSI funding from government and other sources

	2014	2015	
		$	%
Grants—NSW Department of Family and Community Services	$1,250,870	$2,285,689	69%
Grants—Other	$84,085	$327,867	10%
Donations	-	$24,648	1%
Interest	$36,218	$32,900	1%
Rent Received	$102,588	$249,190	8%
Board and Lodgings	$37,674	$109,207	3%
Management Fees	$200,925	$263,608	8%
Total	*$1,712,360*	*$3,293,109*	*100%*

Community Services—$2,285,689 out of a total budget of $3,293,109. Additional programs receive $327,867, but donations ($24,648) comprise only a small portion of the overall income for the agency.

SAHSSI recognizes that they need to diversify their funding base and are seeking to develop opportunities in philanthropic funding. SAHSSI is acquiring a property, using savings accumulated from rental income from Housing NSW tenancies over the years, and is negotiating the donation of land from a local business. However, the potential for private funding of SHS services was thought to be fairly limited-edition.

CHAPTER 11: CASE STUDY 6- CULTURAL PLACES: ROLE IN SOCIETY AND RECONSTRUCTION OF DAMAGED BUILDINGS IN BEIRUT

11.1 Introduction

Culture, according to UNESCO, is "the set of distinctive spiritual, material and intellectual features of a society that encompasses art and literature, lifestyles, value systems, traditions and beliefs".

While the economic, political, and social dimensions of development have all been acknowledged, the cultural dimension of development is still too often misunderstood, or seen as an optional extra to be added when the hard work of 'real' development is done. There is a need to "rehumanize" urban environments and enhance a sense of belonging. Further, cultural practices must be used to increase social cohesion and counter segregation and aim for more integration among residents.

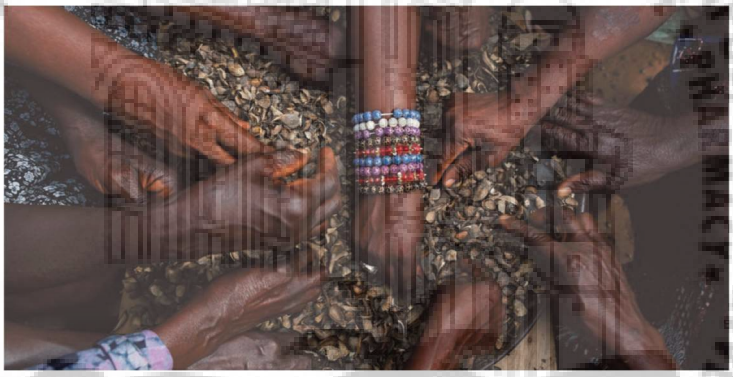
Since 2010, the UN General Assembly has repeatedly acknowledged the role of culture in sustainable development, including a target dedicated to culture under the Sustainable

Development Goals (SDGs). Culture is now firmly recognized by as a key component of strategic urban planning.

11.2 Role of Culture in Society

Culture is what makes cities attractive, creative and sustainable. History shows that culture is at the heart of urban development, evidenced through cultural landmarks, heritage and traditions. Without culture, cities as vibrant life-spaces do not exist; they are merely concrete and steel constructions.

11.2.1 Culture for peace and social cohesion



Culture is the fabric for the dynamic construction of individual and collective identities

Culture enables citizen participation, community empowerment, and social cohesion as it promotes grassroots processes that build recognition and connections within communities. Local cultural activities and expressions can heighten awareness and foster processes that relate inhabitants to the city. Some examples are:

MILAN, ITALY – FORUM DELLA CITTÁ MONDO

The City of Milano has an active platform that connects migrant groups.

TAMAULIPAS, MEXICO – COMMUNITY CULTURE GROUPS

The work of community culture groups has contributed to social cohesion.

11.2.2 Economic development and Tourism

Cultural tourism is a rapidly developing sector for cities. Tourism represents 9% of the world's Gross Domestic Product (GDP) and a higher share for Least Developed Countries. While 40% of all trips include a cultural element, cultural tourism grows 15% a year (against 4 to 5% for overall tourism growth).

Culture contributes to economic progress in a multitude of ways. Local culture forms the basis of creative industries. The production of goods and services incorporate a very strong cultural component. Traditional crafts are highly valued internationally. Some examples are:

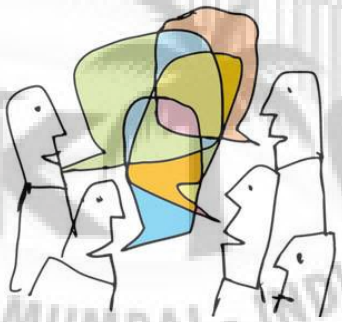
LA PLATA, ARGENTINA – THEATER TRAINING FOR UNEMPLOYED YOUTH

A vocational school for the performing arts in La Plata aims to bring performing arts to a broader audience and trains unemployed youth in theater arts.

OUAGADOUGOU, BURKINA FASO – REEMDOOGO MUSIC GARDEN

Reemdoogo focuses on the artistic and professional education of city youth, linking multiple dimensions of culture: from its intrinsic values to processes of employment.

11.2.3 Citizenship, participation and democracy



Local cultures allow citizens to gain ownership of the city

Culture is a means through which citizens feel they belong to their city. Active participation in cultural processes are important to enable people who are marginalized, to actively participate in society. In divided and post-conflict places, culture can play a positive role in building a more

peaceful society. The active participation of people in local cultural activities (such as poetry, dance, sculpture, theatre, music, etc.) enhances life opportunities.

11.3 Challenges to Preserving Cultural Heritage

11.3.1 Neglect of Cultural heritage

Urban planning that does not explicitly consider cultural issues has negative impacts on the preservation of heritage. It also prevents the exercise of memory, creativity, and coexistence, promotes homogenization, and limits opportunities to access and participate in cultural life.

Urban development policies need to be integrated with heritage conservation

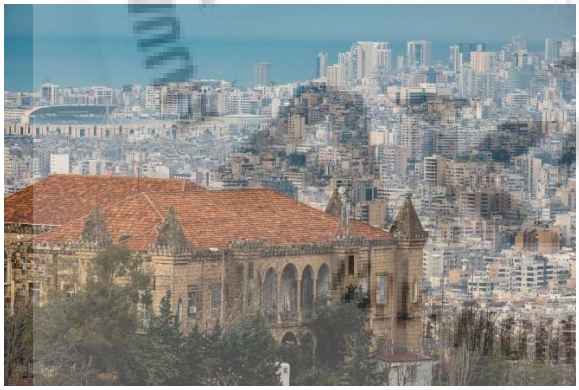
Urban heritage conservation policies are increasingly challenged by urban pressures. Several heritage sites are faced with critical conservation issues such as urban densification. Heritage and cultural impact assessments should be carried out before any major development activity or intervention in a city is undertaken.

11.3.2 Globalization and Homogenization

In a globalizing world, the importance of distinctive urban identity is heightened as a way to counter rapid homogenization. Urban cultural practices – traditional and contemporary – can be weakened by globalization processes, exploitation of economic resources and promotion of tourism. Tourism can potentially harm the ability of communities to safeguard and transmit their cultural practices and sites, or tend to encourage standardized features.

11.4 Case Study of BEIRUT, LEBANON: Reconstruction of Central District and other Damaged Cultural Places

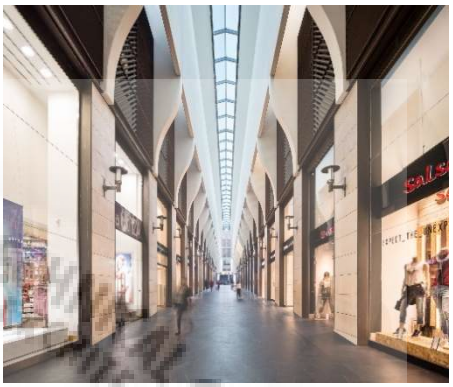
Beirut is one of the oldest cities in the world, located on the crossroads between East and West. Partially destroyed by the 1975 civil war, Beirut is now still under reconstruction and the city center, closely linked to its port, impresses with the architecture of its recently renovated buildings. The reconstruction of downtown Beirut was one of the most significant projects in the world, representing a post-war urban regeneration challenge.



Beirut opens widely on a blue and serene Mediterranean Sea

In 1975, a war broke out in the historic heart of Beirut; the city became the scene of destructive events for 15 years. The Lebanese population of no less than 15 religious communities, whose

past and cultural heritage have no less than 15 historical periods, got destabilized by these events and needs to subconsciously prepare for reconciliation.

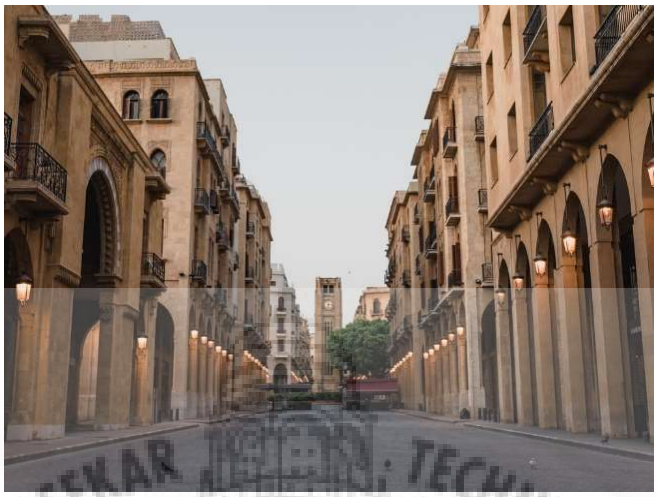


Pictures: Beirut Souk before the war (left), and after redevelopment

Beirut Central District contains sites and monuments spanning 5,000 years and layers of civilizations from the Canaanite to the Ottoman, including the Phoenician, Persian, Hellenistic, Roman, Byzantine, Umayyad, Abbasid, Crusader and Mamluk periods. Underscored in the urban design, and conveyed to the public through lively educational experiences, their importance has made Beirut a historic city destination.

Beirut Central District adjoining the Beirut Port

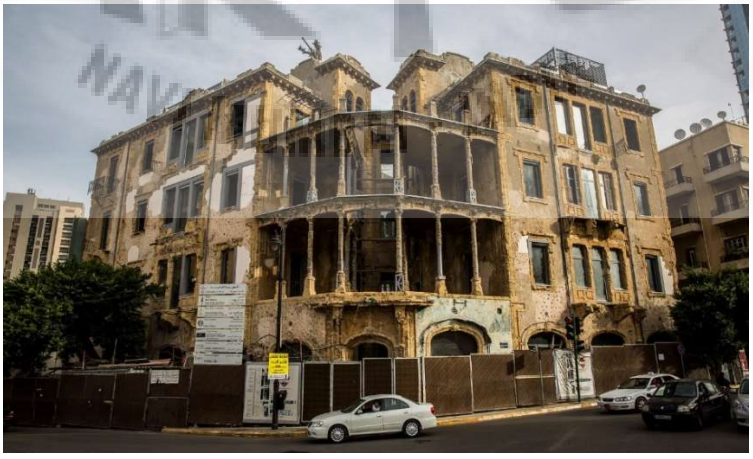
In the aftermath of the war, it was necessary to rebuild. Reconstruction affected an area of about 1.8 million square meters. In the Beirut Central District, 265 ancient structures were renovated. Townscape structures resume pre-war themes, most of them emblematic fountains, souks, religious monuments, city gate stairs. Most of the 265 buildings renovated are concentrated in the historic centre, the square area of Nijmeh.



Some of the reconstructed buildings in Downtown Beirut

Amid the largely privatized post-war reconstruction process, developers and politicians imagined Beirut transforming into a glittering metropolis. But as construction picked up pace, so did the push to preserve the heritage sites that remained.

"It's a matter of identity," says Joana Hammour, one of the organizers of Save Beirut Heritage, an organization formed in 2010 that has pushed to save threatened sites and for legislation that would preserve more. In a country with 18 recognized religious sects and a complicated patchwork of political groups, Hammour says, "We need to have those spaces of collective memory, spaces of gathering, spaces of community, to live together."



Beit Beirut

Beit Beirut is one attempt at creating such a space. The imposing yellow building, elegant despite the bullet holes riddling its exterior, occupies a prominent corner in central Beirut on the former demarcation line that separated East and West Beirut during the civil war. Formerly a family home, it became a snipers' perch during the war.

The building was saved from demolition, largely via the advocacy of local architect Mona Hallak. Under the ownership of the Beirut municipality, it was renovated, and officially reopened as an exhibition space.

Other once-vacant heritage sites have been renovated in recent years and reemerged with a range of uses: as galleries, cultural centers, restaurants, and private residences. But many remain abandoned or under threat. Some sites have been saved from demolition by land disputes and ownership changes or by simple inertia, but their future remains unclear.

Beyond the intangible value of preserving memories, Hammour said, holding onto history can have tangible benefits, spurring tourism and economic benefits. The government, she suggested, should give incentives for owners of historic buildings to renovate their properties rather than demolishing them.

CHAPTER 12: CASE STUDY 7- SOLID WASTE MANAGEMENT: ONGOING CHALLENGES AND FURTHER SOLUTIONS FOR FUTURE URBAN DEVELOPMENT OF MUMBAI

12.1. Introduction

1.1. Solid Waste Management – Of increasing global and Indian concern One of the main current challenges in many urban areas of the world, both in mega cities and in smaller villages, is considered to be municipal solid waste management (UN Habitat, 2010: 1). Due to rapid urbanization, economic development and population growth, the waste generation rates are increasing in several cities of the world, leading to diverse challenges. The ways in which solid wastes generated by human activities are handled, stored, collected and disposed of can pose

different levels of risks to the environment and to the public health (Zhu et al., 2008: 1). Solid waste is therefore a vital municipal responsibility, yet municipal authorities in rapidly urbanized cities find it hard to cope with the accelerating pace of waste generation (UNDESA, 2012: 1).

12.1.2. Mumbai – A rapidly growing city with increasing waste challenges The city of Mumbai is located in western India and is the capital of the State of Maharashtra. Mumbai and its neighboring suburbs, together constituting the Greater Mumbai Metropolitan area, inhabits more than 20,7 million people on an area total of 437.71 square kilometers (UN, 2014: 26; PEARL, 2015: 23; Government of Maharashtra, 2007: 5).

12.1.2.1. Urban Local Governance in Mumbai

The Municipal Corporation of Greater Mumbai (MCGM), formed in 1873, is the local administrative body responsible for the urban local governance in the city of Mumbai (Surjan & Shaw, 2009: 422; PEARL, 2015: 23). Based on revenue and functional responsibilities, the MCGM is the largest urban local body of India. The functional responsibilities of MCGM are divided into smaller subdivisions for administrative purposes, so called wards (Surjan & Shaw, 2009: 422; Rathi, 2007: 116). In total, there are 24 wards in Greater Mumbai, 9 in the city districts and 15 in the suburban districts (Government of Maharashtra, 2007: 5; PEARL, 2015: 24). The wards are highly diversified, e.g. in terms of cost of land and labor (Rathi, 2007: 120).

12.1.2.2. Increasing environmental and waste related challenges

The current MSWM system in the state of Maharashtra is acknowledged as highly improper and inefficient, particularly in major cities like Mumbai (Planning Commission, 2014a: 337). The rapidly increasing amounts of municipal solid waste (MSW) being produced in Mumbai in combination with poor management planning and insufficient financial resources makes today's situation a severe problem (Srivastava et al., 2015: 321).

The problem with MSWM results in diverse negative impacts on the environment, human health, and safety that result in economic, environmental and biological losses (Gupta et al., 2015: 207; Sharholy et al. 2008: 466). The shortcomings of the SWM thus contribute to serious environmental degradation and pollution (Rathi, 2007: 105; Sharholy et al. 2008: 463; Kumar et al. 2009: 885). The situation strains natural resources and causes ecological imbalances with respect to the land, water, and air (Rathi, 2007: 105; Kumar et al. 2009: 888; Srivastava et al., 2015: 322).

The most severe problems regarding the environment and human health consist of infiltration of leachate along with air pollution. During the monsoon and in the rainy seasons that last from June to September, the heavy rainfalls percolates through the waste and soil strata, resulting in increased concentration of heavy metals causing the remaining groundwater resources to face critical stress in quality (Kumar et al. 2009: 885; Srivastava et al., 2015: 323).

Mumbai, being a coastal city, faces greater infiltration of leachate as a result of the sandy soil strata. The location near the sea also results in waste tending to end up in the sea due to disposal sites near the shores (Kumar et al., 2009: 892).

The waste accumulates in the city due to poor handling causing drains to clog. This can result in stagnant water creating favorable breeding places for insects and mosquitoes spreading malaria, dengue fever and other diseases (Kumar et al. 2009: 885; Srivastava et al., 2015: 322). This poses great health risks along with severe air pollution due to the burning of wastes, both unauthorized burning carried out by rag pickers as well as the self-kindled fires caused by the flammable landfill gases (Kumar et al. 2009: 885).

In the future, the problems regarding the MSWM in Mumbai risk to become even more severe as the urbanization and economic growth continues to boom. The population density in Mumbai is already twice as high compared to New York and the population of the city expected to increase with another 7 million people until year 2030 (Sperling et al., 2016: 20; UN, 2014: 26). Studies have indicated that for every 1000 Rs. (15 US$) increase in monthly income, the Indian solid waste generation will increase by one kilogram per month (Chatri & Aziz, 2012: 20). To take action against the problems addressing the MSWM in the megacity of Mumbai is therefore an urgent matter.

12.1.3. Aim and objectives

The aim of this thesis is to study qualitative and quantitative aspects of MSWM in Mumbai in relation to sustainable urban development. The focus is on social and political challenges such as waste management planning, strategies and legislations. Also, potential future solutions will be identified and discussed. Since waste is one of the most vital municipal responsibilities, we aim to highlight the benefits of an integrated and holistic approach of the MSWM.

The objectives are stated as follows:

i. To describe the current waste management situation, inter alia waste amounts, sorting and collection practices, treatment methods and main current challenges.

ii. To make an inventory of current waste management planning divided into an operational (1-3 years), tactical (2-5 years) and strategic (5-25 years) perspective.

iii. To discuss to what extent waste management planning is integrated to urban planning.

iv. To suggest future solutions, methods and possibilities for a more sustainable waste management in Mumbai.

12.2. Case study

This study is a case study of the MSWM system operating in the city of Mumbai. The twin city Navi Mumbai was chosen as a point of reference since the cities are geographically similar. However, the conditions for implementing a more sustainable MSWM are different in Navi Mumbai since it is a planned city constructed on a previously undeveloped area. By studying Mumbai and Navi Mumbai in relation, conclusions can be made regarding the importance of urban planning and governance as well as the influence of factors such as population density. The two cases are of particular interest since they both represent an urban context that is most likely to become more common in the future – coastal megacities facing diverse environmental, social and economic challenges due to rapid urbanization and economic growth.

12.3. Data collection

The following methods were used in order to collect data and information. Besides these methods, it was considered important to participate in the daily life in Mumbai, communicate with citizens and to make observations of the MSWM in the city.

12.4. Mumbai

The current MSWM system in the state of Maharashtra is acknowledged to be highly improper and inefficient, particularly in major cities like Mumbai (Planning Commission, 2014a: 337). The rapidly increasing amounts of municipal solid waste being produced in Mumbai in combination with poor management planning and insufficient financial resources, makes today's situation a

severe problem (Srivastava et al., 2015: 321). Mumbai, being a coastal city, faces several additional problems as a consequence of the inadequate MSWM (Kumar et al., 2009: 892).

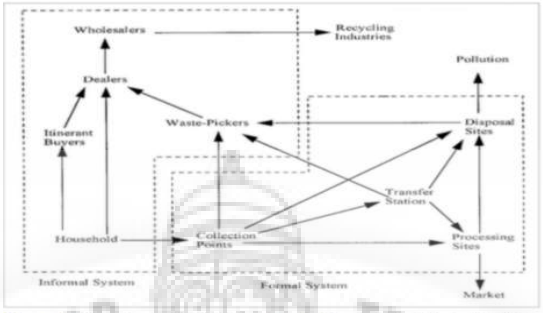


Figure 1: Flowchart of MSWM system in Mumbai (Sudhir et al., 1997)

12.4.1. Waste amounts and composition

The generation of MSW in Mumbai is very high comparing to other metropolitan cities in India as well as in Maharashtra. The city alone generates about 7000 Metric Tons (MT) of MSW per day (PEARL, 2015: 1). In the district of Maharashtra 0.45 kg/capita/day was being generated in the year 2004, which were slightly higher than the average amount for the whole country, 0.37 kg/capita/day (Sharholy et al., 2007: 462).The composition of the MSW generated in Mumbai consisted according to data from the year 2004-2005 of 62% organic materials, 17% recyclables and 21% other materials (Srivastava et al., 2014: 323). The highest amount of organic waste in India was by the year of 2005 reported in Mumbai at 62 % (Srivastava et al., 2015: 321). The moisture content was 54% and the calorific value (CV) was 1786 kcal/kg (Srivastava et al., 2015: 323).

Figure 2: MSW characteristics, Mumbai

12.4.1.1. Collection and sorting practices

The waste collection in Mumbai is managed through a combination of community bins and door-to-door collection (PEARL, 2015: 24). The collection bins that are being used are often not properly designed. There are no separate compartments for segregation, and the bins are in many cases not optimally located or maintained, resulting in poor collection efficiency (Gupta et al., 2015: 211). The average collection efficiency for MSW in the cities of India is stated to be about 70% and in Maharashtra the collection efficiency is stated to be 72 % (Gupta et al., 2015: 211; Sharholy et al., 2008: 462). Efforts to further organize the house-to-house collection have started in several megacities such as Mumbai with the help of NGOs (Sharholy et al., 2008: 462).
In Mumbai, the MSW tends to be strewn around and householders tend to throw their waste into the roadside gutters for later clearance by street sweeping crews, even in areas where storage arrangements are located (Kumar et al., 2009: 884). This is due to both lack of discipline and inadequate placements of the storage arrangements, but also partly as a result of scavenging by rag pickers and stray animals (Kumar et al., 2009: 884).

The MCGM is responsible of regular sweeping of 2000 km of streets in Mumbai (PEARL, 2015: 25) Currently, almost no segregation of the waste is being done in Mumbai since there are generally no separate bins exclusively for collection of different materials (Kumar et al., 2009: 886). The segregation carried out is almost exclusively done by the informal sector. Materials like paper, plastics, metal and glass are being segregated by rag pickers and thereafter sold to different industries for reuse and recycling (Kumar et al., 2009: 885). By the time the remaining waste after the rag pickers' procedures reaches the collecting bins, it therefore contains very little recyclable material and consists mainly of fractions like organic matter, remnants of soiled paper, hygienic and medical waste (Kumar et al., 2009: 885).

12.4.1.2. Transportation

After the MSW has been collected, it should be transported to a processing or disposal site. In most Indian cities, the transportation of MSW is carried out by vehicles of different size(Sharholy et al., 2007: 462). The MCGM operates a fleet of in total 983 municipal and private vehicles of different kind for this purpose (MCGM, n.d.a).

Insufficient transportation causes some of the MSW to accumulate in the city once again after collection (Sharholy et al., 2008: 459; Gupta et al., 2015: 206). It has also been observed that

many of the vehicles used for transportation of MSW have outlived their normal economic life spans, resulting in high fuel consumption, low efficiency and higher expenditure on repairs (Kumar et al., 2009: 884, 892).

In Mumbai, transfer stations are being used (Sharholy et al., 2008: 462; Kumar et al., 2009: 892; PEARL, 2015: 24). A transfer station is a centralized facility where waste is transferred from smaller vehicles to larger ones in order to facilitate the transportation to landfills or dumpsites, since landfills and

dumpsites often are located at some distance from the collection sites (UNEP, 2005: 127). There are in total three transfer stations at Mahalaxmi, Kurla and Versova that support transfer of waste from surrounding areas to the landfills (MCGM, n.d.a)

12.4.1.3. Treatment and disposal methods

The following treatment and disposal methods are being practiced in Mumbai.

Dumping grounds and landfills

Presently there are three major landfills in Mumbai. The two dumping sites Deonar and Mulund, and the scientific landfill Gorai. MCGM is responsible for operating the landfills and has emphasized on implementing a PPP framework for the landfill maintenance (MCGM, n.d.b). Deonar is the largest and oldest dumping ground in Mumbai. It has an area of about 132 Ha and is operating since 1927. The site receives 4000 tons of MSW daily that is being dumped without any treatment. Deonar dumping ground is bordering the Thane creek in three directions, and a slum in the fourth direction (MCGM, n.d.b).

Picture 1: Deonar dumping ground (Google maps, 2016)

Mulund is a smaller landfill located in the eastern suburbs of Mumbai. The dumping site has a total area of 25 Ha along the Thane creek and is operating since 1968. The site receives around 600 tons of MSW per day (MCGM, n.d.b).

Picture 2: Mulund dumping ground (Google Maps, 2016)

Kanjur is the newest landfill in Mumbai, with a developed bioreactor landfill facility. It is also located along the Thane creek and has an area of 141 Ha. The site was handed over to the MCGM in 2003 and is operating since 2015 (MCGM, n.d.b).

Picture 3: Kanjur dumping ground (Google Maps, 2016)

Composting

Composting is mainly being used on a small scale, at local level. India's first large-scale composting plant was set up 1992 in Mumbai by Excel Industries Ltd (Sharholy et al., 2008: 464). The facility has the capacity to handle 500 tons of MSW per day, however the utilized capacity was by the year of 2007 reported to be 300 tons per day due to certain issues (Sharholy et al., 2008: 464).

12.5. Operational level

In this chapter follows the existing plans, strategies and actions taken on the operational level.The operational level refers to short-term planning and strategies. In this report a 1-3 yearperspective was used. Activities and actions taken on an operational level usually involves innovation projects and programs in order to introduce or operationalize new structures, routines, actors etc. on a societal, technological and institutional level (Loorbach, 2010: 170).

12.5.1. National annual plans by the Planning Commission

The Planning commission of the Government of India conducts annual plans consisting of procedures for implementation of different prioritized activities. The most recent annual plan regards the years of 2014-2015 (Planning Commission, 2014b). The plan is mainly focused on budgeting and does not raise the issue regarding waste in any way.

12.5.2. Parisar Vikas Program

The Parisar Vikas Program is an initiative driven by the Mumbai based NGO Stree Mukti Sangathana (SMS). Under the program, female waste pickers are organized into cooperatives and trained in waste collection, handling, processing and transportation practices in a decentralized manner.

The Parisar Vikas Program is supported by the MCGM since 2002, and it is also linked to the ALM system in the way that the cooperatives of waste pickers from theParisar Vikas Program undertake waste management services in housing societies and campuses under the ALM program scheme (PEARL, 2015: 25-26).

The role of MCGM is to provide locations for segregating the waste. The trained waste pickers collect dry and wet waste separately where the wet waste is being composted and the dry waste is being sorted, recycled and sold in the scrap market (PEARL, 2015: 26). There is a fee for the collection of a minimum of Rs.10 per household. The revenue is used by the SMS for carrying out the program. The waste pickers themselves retain their income from the money generated by selling the recyclables from the sorted dry waste (PEARL, 2015: 26).

Picture 4: Women under the Parisar Vikas Program segregating MSW at a sorting shed at IITB campus

Beyond the training, Stree Mukti Sangathana also undertook the following activities under the 1program:

• Organizing women waste pickers and issuing identity cards to them with endorsement from

MCGM.

• Training of women waste pickers in alternative skills such as gardening, vermiculture, operating biogas plants etc.

• Providing childcare and pre-primary education support to children of waste pickers by establishing crèches and kindergartens.

• Health check-ups and health and sanitation outreach and awareness programs for waste pickers.(PEARL, 2015: 26)

12.5.3. Tactical level

Transition management on the tactical level involves steering actions and activities aiming to change the dominant structures in a system. Deeply rooted and well-established patterns and structures such as laws and regulations, infrastructure, routines and institutions need to be transformed. The actors involved in the tactical planning are operating on department level working with policy making, market effects, technology etc. (Loorbach, 2010: 169-170). In this report, a time horizon of 3-5 years is used to define the tactical planning.

12.5.3.1. National five year plans by the Planning Commission

In excess of the national annual plans, the Planning Commission also conducts national five-year plans. The plans provide overall directions and frameworks for policies, programs and schemes. The twelfth and most recent five-year plan regards the years of 2012-2017 with the approach of "Faster, Sustainable and more Inclusive Growth" in order to generate income and employment opportunities to improve the population's living standard, reduce poverty and enable inclusiveness (Planning Commission, 2013: vii).

Several actions regarding MSWM are being mentioned; treatment of MSW should be integrated in the urban development planning, social awareness must increase and the polluter pays principle should be practiced regarding emissions (Planning Commission, 2013: 114).The Twelfth plan also addresses the issue regarding finances for delivering necessary societal services such as SWM and states a need for promoting PPP (Planning Commission, 2013:45).

12.5.3.2. Public Private Partnerships (PPP)

PPP is a rather new phenomenon in most developing countries, especially in Asia. As traditional fundings and capacity in the public sector of developing nations often is limited, PPP gives the Governments an attractive opportunity to be able to both increase and improve their service supply through partnership with private organizations that suits both ways (UN, 2011: 1).
The PPP arrangements often consist of a legally binding contract or agreement of some kind between the concerned partners. The partners share responsibilities and rewards related to this specific project. This collaboration makes it possible to join different types of expertise and resources in an effective way (UN, 2011: 1-2). This could increase and improve the stakeholder's different services, reduce their own individual risks and ease for a preferred solution option (UN, 2011: 1-2).

Some countries have established institutional arrangements to support the development of PPP and in this way also support their own capacity of public services. Excel Industry in Mumbai is one example of this PPP approach (Rathi, 2006: 1195). The company is one of India's larger agro chemical companies that under PPP with MCGM processes organic waste by mechanical aerobic composting (Rathi, 2006: 1195-1196). Waste is collected and transported by MCGM to Excel Industry's facilities that processes about 30–40 tons of waste per day (Rathi, 2006: 1195-1196). The waste is received without any charge from the MCGM. All non-biodegradable and non-recyclable material separated at the site by Excel Industry is later on being transported to dump sites (Rathi, 2006: 1195-1196).
The PPP model is also used in the MSWM of Navi Mumbai. The scientific landfill at Turbhe has a facility for processing and disposal of MSW, managed by the private contractor(NNMC, 2015: 102). The collection and transportation is also managed through a PPP contract (NMMC, 2015: 100).

12.5.4. Strategic level

Planning and strategies on the strategic level involves activities, visions and plans for long term, up to 30 years, development and goal setting. Changes have to be made in the system as a whole, on the societal as well as the technical subsystems (Loorbach, 2010: 168-169). Loorbach points out the importance of debating issues such as norms and values, identity, ethics and long-term sustainability (Loorbach, 2010: 164).

12.15.4.1. Mumbai City Development Plan 2005-2025

Every municipal corporation in India must prepare a development plan to be implemented over 20 years and the current development plan for Mumbai is the Mumbai City Development Plan 2014-2034(MCGM, 2011: 6).

When it comes to MSWM, the plan emphasizes the importance to create more viable options for the disposal of MSW. Limited resources of land are noted as one of the biggest limitations and optimizing already available disposal sites is therefore a very much-observed opportunity. To do so the focus is mainly on three fronts, first of all by instituting "zero-garbage" campaign, aiming to at least reduce the amount of waste that reaches the disposal sites. Secondly by customized technologies for treatment and disposal and lastly by creating more viable alternative landfill sites, the operational disposal sites should all be scientific disposal sites (MCGM, n.d.d).

12.6. Results and discussion

Through the conducted interviews and literature review, this thesis has explored several shortcomings and challenges regarding the current MSWM situation in Mumbai. In this chapter, the most overriding financial, technical and institutional challenges were discussed and analyzed. Further, future opportunities and proposed lines of actions for a more sustainable MSWM in Mumbai were highlighted.

12.6.1. Lack of system approach on all levels

The MSWM in the city of Mumbai faces severe challenges on institutional level, and the most extensive problems according to interviews and literature reviews are acknowledged to be poor planning and lack of coordination between the involved sectors and stakeholders (Planning Commission, 208: 395; Sharholy et al., 2008: 466; Gupta et al., 2015: 208). One of the interviewees also pointed at the lack of [communication between decision makers and the civic society.

According to Loorbach, it is a general societal problem that long-term concerns and governance have no institutionalized place in regular policymaking. Because of political cycles, individual interests and public pressure, the policymaking rather seems to be generally focused on achieving

short and midterm goals (Loorbach, 2010: 169). This theory seems to be highly accurate when it comes to the MSWM in Mumbai.

Another interesting finding from the interviews is the overarching negative attitude towards the field of SWM in India. The negative attitude seems to originate in several causes. Foremost, waste management is acknowledged to be a convoluted business. The work is known to be complicated due to the lack of coordination between different sectors and units as well as inadequacy in legislations, standards and policies (Sharholy et al., 2008: 466). Further, the financial resources are often poor, the staff is known to be inadequate and untrained, the equipment is obsolete and insufficient and there is a general lack of motivation to provide qualitative and timely services to the society (Chatri & Aziz, 2012: 36). This is all adding up to extensive difficulties when it comes to deliver reliable and affordable waste management services.

Furthermore, it is recognized that the negativity and unwillingness towards the SWM in many ways is a political issue. Local authorities often see MSWM as a poor service in comparison to other civic services due to the fact that MSWM can barely recover operating costs (Sharholy et al., 2008: 466). Tipping fees are therefore something that several of the interviewees agreed would improve the SWM situation Mumbai, creating financial opportunities that could lead to several benefits and further investments (Bhada & Themelis, 2008: 148). However, the interviewees were all concerted that introducing tipping fees would be challenging in the context of today's Indian political system. Such a proposal would face great opposition from the society since the handling of waste has been costless for the citizens for such a long time. For the citizens to be willing to pay for waste management services, it is required to create incentives.

12.6.2. Rules are not being implemented

Inadequate implementation of existing rules and regulations has continuously been noted as a major problem by several of the interviewed stakeholders. The majority of the municipalities in India, MCGM included, are known to not take actions regarding the SWM issue in reconciliation with rules and legislations (Sharholy et al., 2008: 466).

12.6.3. Economical aspects

12.6.3.1. Lack of funding & difficulty in obtaining funds

An economic bottleneck, inhibiting further development within the field of SWM, is the lack of funding and the difficulty in obtaining funds from the bank. According to PEARL, the MCGM is one of the wealthiest and most robust urban local bodies in the country (PEARL, 2015: 23).

When it comes to the difficulty of obtaining funds for making investments, several of the interviewees pointed out the problem that banks are generally unwilling to give loans for investments in new SWM facilities. This is due to that the MCGM faces difficulties when give mortgage for land use. Since the land in India is government property and there are no specified land use zoning, land use conflicts are common according to the interviewees.

12.6.3.2. Inappropriate subsidies

Through financial arrangements like allowances and subsidies, it is possible to govern the actions of actors in a field in a certain direction (Ammenberg, 2012: 103). In Mumbai, there are currently no suitable subsidies or economic incentives promoting the use of processed waste products such as compost and RDF. Instead, there are subsidies on chemical fertilizers and the price on coal is generally lower than the price on RDF according to interview data. Further, the potential customers of compost are often located outside the urban areas, on a distance from waste management facilities. Therefore, there is an additional cost for transportation when purchasing city compost. The commercial viability of composting projects is also further threatened as the demand for compost is seasonal (Chatri & Aziz, 2012: 57).

12.6.3.3. Tipping fees

One of the main problems related to the lack of capital is that the present tipping fees are low or inexisting and hence fails to make SWM business profitable and attractive to investors (Bhada & Themelis, 2008: 1). Tipping fees are the main and often sole financial source for the waste operator, making financial viability difficult to achieve with the current policies (IFC, 2013). In India, private companies are in general setting up treatment facilities after signing an agreement with an ULB (IDFC, 2009). Internationally, ULBs often pay some kind of fee to the private company for accepting the waste but in India that is not the case (IDFC, 2009).

Private waste processing companies are facing difficulties running a profitable business due to several reasons. SWM facilities often requires a large initial investment, and the inadequate tipping fees in combination with the inability of products such as compost and RDF to recover the costs of the operation further extends the problem. Furthermore, the burden of paying the tipping fee currently lies solely on the municipality, which also results in serious economical exposure for the municipalities as well (IFC, 2013).

12.6.3.4. Collection and transportation is costly

The expenses for collection and transportation of MSW stands for approximately 80-95% of the total budget allocated for MSWM (Sharholy et al., 2008: 463; Chatri & Aziz, 2012: 15).This makes up for an evident problem since very limited amounts of the already restricted resources reserved for MSWM in the first place remains left for processing and disposal. As mentioned earlier, the current waste management practices in Mumbai are stated to be inefficiently designed which overall makes it more expensive to pursue (Rathi, 2006: 1200). Through the conducted interviews, it became clear that the current procedures for collection and transport implicate some major inefficiencies, leading to rising costs.

Mumbai is an unplanned city and the width of roads and lanes are varying significantly within the city. This poses a problem, not only since many areas are inaccessible for collection vehicles but also since efficient collection and transportation systems will require meticulous planning to ensure successful execution (Chatri & Aziz, 2012: 38). The door-to-door collection is therefore not as organized as it could be, demanding a lot of time and manpower as well as financial resources. The same goes for the collection from bin arrangements due to their often inadequate size and placement (Kumar et al., 2009: 884; Chatri & Aziz, 2012: 39). Further problems are related to inadequate collection vehicles, often obsolete and notoptimally suited for their purpose. The vehicles should be better adapted to suit the prevailing Indian conditions (Chatri & Aziz, 2012: 39).

Due to the fact that collection and transportation is costly, the allocation of funds is corollary being insufficient. In combination with the inadequate enforcement of laws, the practice of open dumping of waste is still rampant in Mumbai and many other Indian cities since it is the cheapest and easiest way to dispose of waste (Chatri & Aziz, 2012: 39).

12.6.4. Several uncoordinated initiatives

12.6.4.1. Compost & RDF

In Mumbai and Navi Mumbai, composting and RDF are two processing techniques being practiced. There is currently no profitable market for this kind of processed waste (Rathi, 2007: 115). The varying composition and low calorific value of the waste stream make RDF insufficient compared to other alternatives like coal and oil. The techniques for RDF are therefore not very much practiced due to its meager demand (Sharholy et al., 2008: 464; Gupta et al., 2015: 214). Compost from composted biodegradable waste could work as a fertilizer but for the same reasons as for RDF, the demand for biological fertilizers is found to be almost non-existing (Rathi, 2007: 115).

Further, another problem is that there are currently no real financial motives for farmers to switch to biological fertilizers since chemical fertilizers are being subsidized by the Indian government (Hati et al., 2007: 127). Another issue that was emphasized during the interviews is that chemical fertilizers are well proved to be working in contrast to the biological fertilizers that are facing great suspicion. The fact that the biological compost is being obtained from waste leads to the presumption that the product is inefficient or even harmful, containing toxins and pollutions. This issue with the mistrust of biological fertilizers highlights the problem with negligence and the in general negative attitude towards waste and waste management.

12.6.4.2. Technology has yet to be seen proven on working plants

In India in general, there have been many controversies in the scientific and environmental arena for some of the emerging waste management technologies such as incineration, gasification and RDF (Chatri & Aziz, 2012: 40). In order to be more practiced and relied upon, the technologies have to be seen proven on working plants. Processing technologies such as RDF and compost plants require availability of wastes of a certain quantity and composition in order to be able to operate smoothly (Chatri & Aziz, 2012: 40). This is something that is currently difficult to secure in Indian conditions. The issue regarding the technological reliability therefore goes hand in hand with the challenge regarding lacking segregation described in chapter 6.8.1.

To overcome the addressed problems regarding technical reliability is not an easy task. According to the UN Habitat, it is important to be conscious when imagining ideal systems,

technologies and solutions of the developed world, trying to copy them to solve problems. Since the context is often entirely different, local relevance might be lacking in many cases (UN Habitat, 2010: 1). This statement seems to be relevant when it comes to Mumbai. Many of the SWM practices currently in operation are noted to be inefficiently designed. This is partly a result of directly adopted techniques from abroad without India and Indian scenarios in mind (Rathi, 2006: 1200; PEARL, 2015: 2). Some of the technologies are stated to be more or less directly implemented with poor adjustment to national and local conditions, which in many cases make them insufficient or even failing (PEARL, 2015: 2).

12.6.5. Public awareness

From personal communication with officer level stakeholders during the interviews, a reappearing topic was the problem regarding public awareness. The citizens are the ones that according to some stakeholders should carry the main responsibility regarding segregation. This problem arises since the general perception seems to be that it is the duty of municipalities to handle civic services such as waste management, to look after them and make sure that they are functioning properly (Rathi, 2006: 1199).

A need for change in people's mindset were therefore repeatedly brought to attention during the interviews along with the great possibility that actually lies within this issue if a solution or even an apparent improvement were able to be brought into action. In Navi Mumbai, NMMC is addressing this issue by conducting regular awareness campaigns such as programs, advertisements and documentaries, mostly throughout help from NGO's (NMMC, 2015: 10).

12.6.5.1. Segregation at source

One of the main challenges that have been highlighted by all actors is the lack of segregation at source. Further segregation was also regarded as one of the main opportunities for improvement of today's waste management situation according to several of the interviewed stakeholders. According to Kumar et al., proper segregation of waste would lead to a more optimized waste management, giving better opportunities for scientific disposal (Kumar et al., 2009: 887).

As of today, the composition, quality and quantity of the waste stream is very much varying. Composition of MSW is homogenous in nature but also due to lack of segregation as well as external factors such as seasonal variations. This obstructs a reliable final treatment. Varying

quality of the end product further extends the skepticism and segregation is therefore highlighted to be of great importance for successful waste management facilities (Sharholy et al., 2008: 460; Gupta et al., 2015: 214).

12.6.6. Future solutions and opportunities

In order to improve the future outlook, potential solutions and more lined out strategies are important. It is clear from the earlier observed challenges that there is an overall need for improved coordination, proper planning and greater consideration of several financial, technical and social aspects. The following section discusses possible lines of actions and approaches with respect to the identified challenges from the previous section.

12.6.6.1. Coordination and a system approach

According to the United Nations Department of Economic and Social Affairs (UNDESA), urban managers in developing countries should focus on a more holistic and system-oriented approach of SWM. It is required that the focus of waste management shifts beyond the earlier "end-of-pipe" solutions towards a more sustainable system-oriented approach (Singh et al., 2014: 803). The highest priority should be on waste prevention, waste reduction, and waste recycling instead of just trying to cope with the constantly increasing amount of waste through treatment and disposal. This kind of integrated approach will help reducing the pressure on landfills as well (UNDESA, 2012: 13).

A functioning SWM system should involve all the stakeholders in planning, implementing and monitoring changes (UN Habitat, 2010: xxiii). The aim should be to create a network of components, together consolidating a sustainable MSWM system. A strong and transparent institutional framework is also essential to good governance in long term functioning of SWM. Underlying issues related to management structures, contracting procedures, labor rpractices and corruption needs to be taken into account (UN Habitat, 2010: xxiv).

Furthermore, there is a need for an even broader system approach regarding waste management, putting it into the context of global resource management. Resource management should aim towards a concept of zero-waste, reusing and recycling to a greater extent (Singh et al., 2014: 807, 810). The relevance of sustainable resource within sustainable development has recently been recognized and obligates a high degree of cooperation between involved actors (Agudelo-

Vera et al., 2011: 2300). This requires joint visions, clearly defined objectives as well as distinguished roles and responsibilities of the actors (Singh et al., 2014: 810).

It is also important that the technical solutions of the MSWM system should be integrated on a societal level by unifying them with social factors such as politics, education and organizational structures. Such social structures are vital when it comes to establishing and supporting the technical solutions.

12.6.6.2. Public Private Partnerships

Regardless of different operational models, private sector involvement in service delivery through e.g PPP has lately become an important option for improving cost-effectiveness, quality and coverage of infrastructure services worldwide (Chatri & Aziz, 2012: 41; UN Habitat, 2010: xxiv). In section 6.1, the issues regarding the MSWM in Mumbai have been recognized to not primarily be the paucity of funds but rather a lack of coordination as well as several shortcomings on institutional and financial level. Private sector initiatives aretherefore presenting an alternative approach to the public delivery of MSW services, in many cases providing more efficient and cost-effective MSW services (Chatri & Aziz, 2012: 43).

In Mumbai, it has been found that the cost per ton of MSWM can be greatly decreased with community participation and PPPs. A study by Rathi, researching alternative approaches for better MSWM in Mumbai, proves that the cost per ton of waste management is at its highest when MCGM is the only facilitator of the waste management in the city
It is found that the cost per ton of waste management is 1518 Rs. (US$ 35) with community participation, 1797 Rs. (US$ 41) with PPP and 1904 Rs. (US$ 44) when only MCGM handles the waste (Rathi, 2006: 1200).

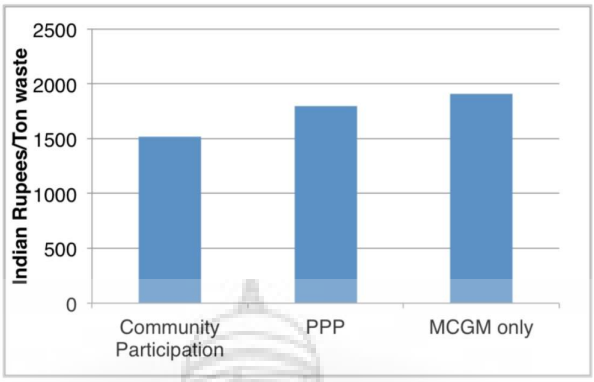


Figure 4: Cost comparison MSWM in Mumbai

The substantial reduction of cost with community participation is due to the improved segregation at source, which leads to reduce transportation costs. The PPP cost model involves mainly improvements in processing of the waste without any specific actions regarding collection and transportation and hence the cost per ton of MSWM is higher (Rathi, 2006: 1200). To make PPPs an optimal approach for the MSWM in Mumbai, actions regarding collection and transportation is therefore needed as well.

In Navi Mumbai, PPP is already an adopted model for MSWM. Private contractors are managing collection, transportation, processing and disposal of the waste (NNMC, 2015: 100, 102). Several updated technologies such as weigh bridges for keeping track of data on waste quantities. RDF and windrow composting have been implemented on the Turbhe landfill facility. However, the processing facility is facing difficulties making profit due to the earlier addressed problems regarding lack of funding and a market demand for the final products. Hence, to overcome such institutional and financial obstacles is also needed in order to make PPPs profitable not only in theory but also in practice.

12.6.6.3. Integration into urban planning

In a world of rapidly urbanizing cities, it is becoming clear that sustainable urban development is a crucial challenge. Many of the problems regarding urban sustainability and MSWM can possibly be addressed through urban planning (Agudelo-Vera et al., 2011: 2995-2996). To handle the complex problems of urban areas, it is crucial to manage resources strategically and in a holistic way. The relevance of formal links between sustainable resource management in both urban planning and sustainable development has lately been recognized, and it is clear that there

is a need to integrate these approaches into an overarching concept in order to achieve urban sustainability in the future (Agudelo-Vera et al., 2011: 2302).

Furthermore, it is important to understand that moving towards more sustainable cities is not solely a technical task. Urban planning, infrastructure development and networking strategies can be implemented to generate social and cultural adoptions, leading to fundamental changes in the behavioral patterns of urban residents (Agudelo-Vera et al., 2011: 2299). It is therefore possible that the resource usage and waste disposal patterns of the Mumbai citizens can be affected through integrating the MSWM into urban planning in a strategic way.

As mentioned in chapter 6.6, implementing a sustainable and integrated SWM system should involve consideration of regulations concerning land use in order to e.g. determine suitable locations for waste processing facilities. A study conducted by Onu et al., investigating the impact of inadequate urban planning on MSWM in Nigeria, states that "urban development planning should integrate all the society's land use needs in a sustainable manner" (Onu et al., 2014: 31).

To in practice the process of land use zoning to a greater extent in Mumbai in the future could therefore be an option. By land zoning, land can be divided into regulations providing specifications for land use such as residential areas, industrial and commercial areas. The land use should be allocated in accordance to the expected future use, and all urban development planning within the urban area should be in line with the land use plan (Onu et al., 2014: 31). This strategy would address the problems in Mumbai regarding SWM facilities facing opposition from neighboring residents as well as the mortgage problem. By proper and detailed land use planning, adequate guidance for locations of waste processing facilities can be provided. The land use plan will also be useful to decision-makers as urban areas developand expand (Onu et al., 2014: 31).

12.6.6.4. Create economic incentives

Mortgage for land use & tipping fees

The principle of PPP is, as stated earlier, seen as an approach with great possibilities. However, the participating companies are presently facing severe problems regarding financial capital. User charges for SWM services are crucial but currently inadequate to make the operation profitable

and thus attract more private investors (Bhada & Themelis, 2008: 147). It is necessary for municipalities to pay private companies a tipping fee for the waste being treated since neither RDF nor composting can manage to cover the costs of the operations with respect to the current outlook of their markets (Debnath & Bose, 2014: 92). These fees should also be modeled and implemented in such way that the enrolled private companies have proper incentives to carry out a more sustainable final treatment of the waste and reduce the amounts going into landfilling. The MoUD states that all authorities in MSWM projects have to share the costs. Suitable tipping fees needs to be determined and agreed upon by all participating parties (MoUD, 2015: 18).

Waste as a resource

To address the difficulties regarding finances, economic incentives and better availability of fundings is needed in order make waste management appear as a profitable business. Subsidies are needed especially for treatment techniques regarding WTE and composting in order to make these methods more profitable and in this way more practiced. They both have been highlighted as future alternatives with great potential. A greater availability of fundings is therefore needed to further support increased investments that would stimulate the technical expansion, in this way supporting and making way for technical development (Kumar et al., 2009: 894; Gupta et al., 2015: 212; Srivastava et al., 2015: 326). If the ULBs have better access to finances, they will be better positioned to improve and explore alternatives that can improve the SWM situation e.g. better equipment, human resources and technology (Chatri & Aziz, 2012: 53).

The general perception of waste also needs to change and waste needs to be seen as an opportunity rather than a useless product in order to obtain maximal achievements regarding both environment and finances (Srivastava et al., 2015: 328). If regulated properly, there is a huge opportunity of meeting the increasing demand of both energy and employment by nusustainable MSWM (Srivastava et al., 2015: 333). Over the last few decades, application of traditional as well as innovative technologies has made production of several goods from waste possible, e.g. manure, bricks, RDF, electricity and products from recyclables (Chatri & Aziz, 2012: 57). In the future, the financial and commercial viability of such SWM projects must be ensured by securing the availability of the right quantity and quality of the waste stream as well as a market for the goods being produced.

Media, Internet and science also play a very important role when it comes to influencing public opinions and putting SWM issues on the societal and political agenda (Loorbach, 2010: 170).

12.6.6.5. Standards & policies

Reliable data about of the generated solid waste would ease for appropriate planning and is therefore essential for a more efficient SWM system (Srivastava et al., 2015: 321). The government and other stakeholders should therefore come together to address the issues regarding the gap in the data of waste quantities, quality and composition (Chatri & Aziz, 2012: 77). To allow more informed decision-making, an updated surveying of the waste characterization should be done. In order to obtain reliable results, a large number of samples have to be collected since MSW is as heterogeneous as it is, even by nature (Sharholy et al., 2008: 466).

Furthermore, the market supplies and demand for goods produced from waste do not match at present. To make processed waste such as compost and RDF an alternative option to chemical fertilizers and coal in the future, standards and policies for these products are needed. Data on emissions, hazardous substances, calorific value etc. need to be standardized in order to make compost and RDF into the market by making them reliable options for companies, plants, factories and other potential customers. Through the interviews, it was made clear that there is also a need for discussions and communications between the producers and the end users of these products.

12.6.6.6. Segregation: only inert materials to landfill

The final treatment of the waste would be overall improved by improved segregation since it would lead to better options and opportunities for scientific disposal (Sharholy et al., 2008: 466). It would also reduce the pressure on landfills by reducing the amounts of waste being disposed of at these (Sharholy et al., 2008: 464, 466). Land required for landfills and open dumps must be reduced by adopting suitable waste processing technologies like composting and WTE. Application of such technologies requires stringent implementation and monitoring mechanisms in order to be successful on the market and to be environmentally sustainable (Chatri & Aziz, 2012: 42).

Since the proportion of biodegradable, organic waste generated in Mumbai is high, composting

was often highlighted as a good treatment alternative by the interviewed stakeholders. This viewpoint is shared by several other sources, stating that composting is a simple and cost-effective technology for treating the large organic fraction of MSW produced in Indian cities (Gupta et al., 2015: 213; Chatri & Aziz, 2012: 56). By conducting proper composting after proper segregation, the final waste volumes are stated to be able to be reduced by 50–85% (Sharholy et al., 2008: 463). Proper composting would therefore ease the load for collection and transport and reduce the pressure on the landfills (Sharholy et al., 2008: 464; Srivastava et al., 2015: 326). Composting facilities is also suitable to set up in both centralized and decentralized systems unlike WTE projects that are not fit for decentralized systems due to feasibility issues (Chatri & Aziz, 2012: 56, 58).

Furthermore, a proper segregation could result in environmental benefits in terms of decreased stress of limited natural resources since it most probably would advance recycling, recyclables could be straightway transported to recycling units (Sharholy et al., 2008: 466).Also, further and consistent segregation would result in a more invariant and standardized end product. With a segregated and more invariant composition of the final waste the operations for final treatment can be further standardized with more efficient and reliable results (Gupta et al., 2015: 214; Sharholy et al., 2008: 466).

12.7. Conclusions

It was concluded that the MSWM in Mumbai is facing many challenges and that there is a lack of coordination and a lack of system approach on all levels. Further, a deeply rooted negative attitude towards the field of MSW could be observed. The main problems were shown to be related to politics and people's mindset. The current MSW situation in Mumbai faces several highly complex problems that are deeply rooted in different societal domains, on various levels, involving various sectors and stakeholders with separate interests and perspectives. Since the problem is surrounded with various structural uncertainties, the solutions are not easy to find. In order to address these numerous and widespread issues there is a need of a more holistic approach.

The overall conclusion is that it is not enough that a small fraction of the society, with partially contradictory interests, is taking initiatives to improve the MSWM in Mumbai. In order to

achieve a sustainable long-term solution, coordination and a more holistic system approach is necessary. The MSWM system can be seen as a typical case of a sociotechnical system. Changes in such systems involve several actions in different areas (e.g. social, technical, financial, institutional) and on different levels in the society. It is clear that the current challenges regarding the MSWM in Mumbai cannot be solved solely through technical means. To support the technical solutions, it is important to view the technical systems as a part of a bigger sociotechnical system and incorporate them with organizational and political solutions as well. Hence, participation from and interactions between different stakeholders and actors is absolutely necessary in order to develop support for policies.

Several rules and plans have been put to legal force accompanied by several initiatives with the intentions to improve identified shortcomings, such as ALM, PPPs and the Parisar Vikas Program. Nonetheless, most of these actions have failed to succeed due to financial and institutional obstacles. The problems identified as most overruling were the inadequate implementation of rules, lack of coordination and difficulties to obtain funds and revenues. The lacking implementation of rules together with poor coordination throughout the society has left the current MSWM with great inefficiencies, and financial constraints have deserted many promising projects with great losses.

Regarding the promising approach of PPP, there is a need to take it to the next level in order to be able to leverage private sector efficiency into the SWM of Mumbai. Since value of the waste is the most important reason for private sector participation, it is important to understand the market for processed waste products such as compost and RDF. Standards, policies and regulations need to be put in place in order to mitigate the revenue risks.

The question whether to aim for a centralized or decentralized operational MSWM model in the future was proven to be convoluted. There are several advantages and drawbacks with both centralized and decentralized models and many external factors must be taken into account. Thus, a mix of centralized and de centralized MSWM was presumed to be the model seemingly to be most beneficial in the case of Mumbai. For example, segregation of MSW would most probably be more efficiently carried out on a decentralized, local level. On the other hand, treatment and processing of MSW seems to be best carried out on a centralized level. Several

activities such as transportation would probably become more efficient and the facilities would be easier to monitor.

Regardless of the choice of operational model, a sufficient MSWM requires proper infrastructure and a well thought out urban planning. It was concluded that there is currently no formal integration of SWM into urban planning in Mumbai. Correlating to the increasing urbanization and industrialization, the urban sustainability planning of today has become increasingly complex over the last few decades. In many cases, this might lead to conflicts of interests among various stakeholders. To address these problems, land use zoning was highlighted as a method to promote a more sustainable and organized urban planning. Land use plans give planners and decision makers room to integrate environmental, technological, economical and political concerns of the citizens in the planning and implementation of various projects, e.g. MSWM projects. To move towards urban sustainability in the future, there is a need for a comprehensive framework that integrates waste management and urban planning.

To be long-term sustainable, there is a need for a broader system perspective, putting SWM and urban planning into the context of global resource management. The concept of SWM should not be limited to only handle current problems related to treatment and disposal, instead it should be extended with the aim to solve resource management issues related to the unsustainable production and consumption patterns. In order to do this, there is a need for a worldwide shared vision among the involved actors.

It is important to understand that sustainability is not a fixed state but rather a continuous and constantly changing process where resource management, technical solutions and institutional changes are made with the aim to make overarching coordination and optimization easier. To enable sustainability on a global level we need to transform the relationships between society, environment and technology. Waste should no longer be seen as an unprofitable product but a useful resource.

CHAPTER 13: CONCLUSION

As urbanization is increasing speedily, so are urban issues. While some of these issues are specific to a certain city, many of these are relevant in a global context, such as loss of green areas, pollution, and neglect of cultural heritage. In our project, we have developed first-of-its-kind assessment and comparative framework for analysis of cities. This framework incorporates a wide range of qualitative and quantitative parameters.

For the purpose of this project, we chose 4 cities (Doha, Beijing, London and Washington, DC) for our analysis. However, this framework can be effectively used for analysis of practically any city in the world. The summary of results obtained after assessment of the four sample cities is as follows.

1. **LAND USE:**

	Doha, Qatar	Beijing, China	London, UK	Washington, DC, USA
Land Use Classification	Developed land increased by four times in the last three decades.	Beijing is facing a huge challenge to manage the growth of its built-up area whilst also retaining both productive arable land and land for conservation purposes in order to simultaneously realize the three aims of economic development, protecting arable land and generating environmental improvements	More amount of land is use for residential purpose, open spaces also occupies major land, rest of land is use under offices, commercial sectors, etc.	The DC comprises 69 square miles. Land use patterns reveal an expansive city "core" of about four square miles centered on the open spaces of the federal city. The core is surrounded by an inner ring of moderate to high density residential and mixed use neighborhoods. Beyond the inner ring is an outer ring of less dense development.

Zoning Laws, Governance and Municipality	Ministry of Municipality and Environment is responsible for zoning activities. Planning zones are divided into 3 categories: First includes Residential, Industrial and Urban areas. The second group includes areas of sensitivity such as that of heritage value. The third group includes community and recreational facilities.	Beijing Municipal Commission of Urban Planning and responsible for the formulation of various urban and rural plans.as approved by the Ministry of Construction of China, BICP is a grade a planning and Design organization and aims to provide the services for Beijing municipal government	Government of London operates within a relatively centralized, unitary state. Zoning law and it's ordinance detail whether specific geographic zones are acceptable for residential, commercial or industrial purposes. London is hub for small and medium businesses, thereby it contributes major amount of cities GDP itself. Residential area is rapidly growing which makes residential zoning on huge note.	The D.C. office is responsible for the formulation of various urban and rural plans. Zoning was done in a such a way that the city contain mostly residential areas and commercial areas, government offices and business hubs. Industries are kept out of the city

Open and Green Spaces	The proportion of vegetation in comparison to urban area decreased from 11% in 1987 to 5% in 2013. There is a general lack of open public spaces at the neighbourhood level.	Beijing will create 600 hectares of urban green space in 2018 to improve the city's living conditions The figure will increase the city's green coverage rate to 48.3 percent, compared to 46.2 percent in 2012 during the past five years a total of 40022 hectares of green spaces were created in capital	With 3,000 parks in city designated by the boroughs as 'public open space', which gives the title of 'Green city' to London. Parks, gardens and recreational area spread in 9294 ha and it occupies about 5.83% of total land use of open space in greater city of London. Other land use includes, Natural and Semi-Natural Urban Greenspace and green corridors covers about 14668 ha that is 9.2% of total free space.	Parkland comprises approximately 20 percent of Washington's land. Almost 90 percent of parkland — more than 6,700 acres, including Rock Creek Park, the National Mall, Anacostia Park, and the Fort Circle Parks — is under the National Park Service's jurisdiction. Another ten percent is owned and managed by the government of the District of Columbia's Department of Parks and Recreation.

Cultural Places	Souq Waqif and Museum of Islamic Arts are among cultural sites in the city.	Beijing is well known for its numerous parks playgrounds and recreational uses.	Culture of London concerns the music, museums, festivals and lifestyle within London, the capital city of the United Kingdom. The city is particularly renowned for its theatre quarter.	African American history and culture at the museum, Anacostia Community Museum, United States Capitol Building, etc. are among cultural sites in the city.
Industrial Area	Heavy industries are located away from the city. A light industrial zone is located on the outskirts of the city.	Beijing is largely a post-industrial economy and has the biggest tertiary industry as a proportion of GDP among all Chinese cities.	City's economy is dominated by service industries. London city has industries and companies like Automobile industry, Gas station and petroleum companies.	Heavy industries are located away from city. On the other hand, all the government offices and private MNCs' headquaters are located within the city itself.

2. TRANSPORTATION INFRASTRUCTURE:

	Doha, Qatar	Beijing, China	London, UK	Washington, DC, USA
Road System	The road system in Doha is in the form of Radial Ring Roads.	The road system in Beijing is in the form of ring roads (beltways) system.	The road system in London is in the form of Radial Ring roads system. City is connected centrally with other distance places.	The road system in Washington DC is in the form of Radial Ring Roads.
Travel time and Congestion	High levels of population growth due to immigration have resulted in a degraded built environment and increased vehicle congestion.	Beijing is one of most congested cities in the world, with over 6 million car on its roads, The average number of extra hours spent due to traffic congestion were 149 hours per commuter in 2019	Time traveling and congestion reduce due to public transport facility. Congestion charge applied by government. Fee charged on most motor vehicles operating within the Congestion Charge Zone (CCZ). This helps to	Washington, DC's Metro is one of the busiest public transportation systems in the country. Most people use metro and metro bus services for their travel.

			control congestion and reduce time travelling in the city.	
Public Transport System	As fuel is cheap, public buses are used only by a tiny fraction of the population. A metro rail network recently completed its first phase of construction and is now operational.	The Beijing Public Transport Holdings, Ltd. ("BPT") is the main bus and trolleybus operator in the city. It is owned by the city and Beijing had more than 28,343 buses carrying over 13.39 million person/trips a day.	Public transport reduces the congestion in the city. Tramlink, Metro rail, underground rail, buses and River bus are the major mode of public transport. A single London bus journey costs £1.50 which is very cheap. More than 3 million passengers travel on the Underground every day, which helps to reduce congestion.	Washington, DC's Metro is one of the busiest public transportation systems in the country. Most people use metro and metro bus services for their travel.

Cycling Infrastructure and Walkability	Walking and cycling are not very popular due to several reasons such as large distances between places, high summer temperatures, roundabout junctions, etc.	Beijing has long been well known for the number of bicycles on its streets. Although the rise of motor traffic has created a great deal of congestion and bicycle use has declined	Walking in London city is one of the way of transportation to nearby area. As walking path, cycling path and most of the skywalks are major mode of people transportation in city of London.	Washington, DC is a model for walkable urban development, particularly due to its balanced development of center city and urbanizing suburbs. Various iinitiatives are taken to provide stress free and comfortable riding, new programs for cycling and new routes are also undertaken for further growth in cycling.

3. HOUSING:

	Doha, Qatar	Beijing, China	London, UK	Washington, DC, USA
Types of Homes	Almost half of the homes fall in the category of Flats or apartments.	Until 1949 Beijing was a completely traditional courtyard city, rapid economic growth have almost wholesale destruction of traditional houses. Now most of the houses in city are flats and apartment	Flats 2-level flats Studio flats Converted flats Detached house Semi-detached house Terraced houses End of terrace house Cottages Bungalows Mansions	Federal type, contemporary, Craftsman, Victorian

Affordability in Sale and Rent Prices	Rent prices are on the higher side due to gap between demand and supply of housing units	you can rent a room in Beijing for between 1,000 and 2,000 Yuan on average. Beijing hotel rooms can also be found at affordable rates	The distribution of prices for new and second hand homes diverged in 2015, with more new build homes priced between £350,000 and £500,000. The affordability of owner occupation is at its worst ever level in London, while in the UK as a whole houses are still a little more affordable than they were before the recession	D.C. real estate prices have soared as the city has started attracting wealthier residents. As a result, finding an affordable home to purchase may be challenging. According to the National Association of Realtors, the median sales price of a single-family home in the Washington, D.C. metro area is $417,400. That's more expensive than both New York City ($403,900) and Philadelphia ($224,600).

Homelessness rate/ Slums	Slums are practically non-existent. However, migrant labourers sometimes end up living in desperate conditions.	Many ambitious people came to big city themselves in the hope of improving their family situation but failed.This has caused massive rural-to-urban migration	According to 'The Guardian' news articles, the number of households considered newly homeless or at risk of becoming so has increased by 11.4% across England in 2018, according to government figures, a rise of almost 7,000 households. With increase in number of 7000 homeless people in London in 2018, the capital city becomes the highest number of homeless city of entire UK.	The number of homeless in Washington, D.C., grew by 34% between 2009 and 2016. The city has 124 homeless for every 100,000 residents. High cost of living in the nation's capital is to blame.

4. ARCHITECTURE AND URBAN DESIGN:

	Doha, Qatar	Beijing, China	London, UK	Washington, DC, USA
Styles of architecture	A mix of traditional, local architecture with modern style.	Beijing has a range of architectural styles	Mix tradition of architecture, including Middle Age; Norman, Gothic and Tudor architecture to Postmodernism	A mix of traditional, local architecture with modern style.
Historical Development	In earlier times, homes were built using local materials such as palm leaves, stones and mud. Residential buildings were low-rise. In the 1960s, settlement patterns were	In earlier times, homes were built based on the local building materials such as palm leave.s, stones and mud. Residential buildings were low-rise, spacious	England had no capital city. However, the institutions of central government were moved to Westminster, close to London. This and the rise of trade in the area were two decisive factors in	Washington, DC is a planned city, intended to serve as the nation's capital. Throughout the city's history, major plans and significant local and national events have

	determined by the development of modern infrastructure such as roads and water supply. Since the 1990s, Doha's urban growth has been progressing at a much faster rate, which is attributed to a transition from oil-based toward a competitive and more globalized economy.	courtyard houses. The design followed the Chinese courtyard tradition of dividing male and female spaces	London's emergence as the capital of England.	shaped its design and growth
Features of Traditional architecture	The traditional Qatari wall, wind tower and wall alcoves are some examples of traditional architecture.	China has a unique and time-honored architectural tradition, dating back to the Zhou era 2,500 years ago Discover the reasons behind its features	Traditional architecture used by architects and builders includes a commitment to maintaining a link to the past styles of building, reuse of materials or designing homes and building to stay consistent	Three factors have radically influenced the style of Washington's architecture: restrictions on the height of structures, Classicism and conservatism. Yet, in the mid-20th century,

			with the overall building design of the area.	Modernism began to have a noticeable effect.

5. SANITATION FACILITIES:

	Doha, Qatar	Beijing, China	London, UK	Washington, DC, USA
Water Supply	The city has one of the highest consumption of water per capita per day, around 400 litres. The city relies on desalination for drinking water.	Beijing is one of the most water scarce cities in the world. Total water use is 3.6 billion cubic meters	Water supply system developed over the centuries from sixteenth upto present period. Many different companies supply water to city. On an annual basis, the City of London performs over 12,000 water quality tests.	DC Water provides more than 681,000 residents and 21.3 million annual visitors in the District of Columbia with retail water and wastewater (sewer) service

Sewage Management	The sewage treatment plant in Doha uses primary, secondary and tertiary treatment units for treating predominantly domestic sewage.	Up to 2014, Beijing had 50 medium and large-sized waste water treatment plants with the total capacity of 4.25 million tons/day	The City of London operates five wastewater treatment plants and 38 pumping stations. Some famous water treatment and sewage treatment plant are Beckton Sewage Treatment Works and Thame's wastewater treatment plant.	DC Water's Blue Plains Advanced Wastewater Treatment Plant is the largest plant of its kind in the world. On an average day, the facility treats close to 300 million gallons of wastewater and has the ability to treat over 1 billion gallons a day at peak flow
Solid Waste Management	The city generates around 1.8 kg of solid waste per capita per day, which is among the highest in the world. The predominant method of disposal is landfilling.	There is a dual waste management system whereby rubbish is collected either by the municipality or by informal waste pickers.	Environment Committee is investigating aspects of London's waste generation, handling and disposal, to inform the development of work under the Mayor's Environment Strategy and other policies. The three	Washington State University is committed to the proper management of its solid waste by diverting its solid waste from the landfills to reuse and recycling programs

			aspects for particular focus are-Waste reduction and the Circular economy, Recycling, Energy from waste.	

6. ENVIRONMENT AND SUSTAINABILITY:

	Doha, Qatar	Beijing, China	London, UK	Washington, DC, USA
Climate Change	Qatar is ranked first in the world in terms of CO2 emissions per capita.	Beijing air quality has improved significantly since the start of the war on pollution seven years ago according to official figures In 2019 the capital's average concentration of PM2.5 – the most harmful small particles and a key indicator	London's climate is changing year by year. City having hotter, drier summers and warmer, wetter winters. It also having extreme weather like heavy rainfall and heatwaves more often. Most scientists agree that	Change in climate already caused 2 degree Fahrenheit rise in temperature as compared to 50 years data in Washington DC. Warming more than the average nationwide.

		of air pollution – fell to their lowest levels since its integrated air quality monitoring network started operating in 2013.	this is caused by human actions that emit greenhouse gases like carbon dioxide.	
Green Buildings	Qatar has the second most number of LEED Certified buildings in the Middle East. Qatar has its own assessment system called Global Sustainability Assessment System (GSAS), which is billed as the world's most comprehensive green building assessment system.	The 2017 China Green Building Report by CBRE Research said the green building concept has been accepted by more and more property developers and local governments in China.This has already made China the world's second-largest market for LEED certified projects, trailing only the United States.	With the end of 2016, London recorded highest number of Green building in the world after Paris and Singapore. London has 33 LEED certified buildings and 1696 BREEAM certified buildings which makes London a central hub of sustainable and green building construction.	Washington DC has long been a leader in green building, and LEED has been the rating system of choice in the district for decades.

Energy Efficiency	Per-capita electricity consumption in Doha is among the highest in the world, about 14,400 kWh/year.	China is also the world largest renewable energy producer. China is largest producer of hydroelectricity, solar power and wind power in the world. Electricity Consumption in Beijing reached at 4128kWh/year	London consumes great amount of energy, in 2013 total final energy consumption stood at 132,000 Gigawatt hours 7 equivalent to a pile of coal that would cover the One Canada Square tower in Canary Wharf.	Since 2012, the DCSEU has worked with DOEE and local contractors to install more than 500 solar photovoltaic (PV) systems on single-family affordable housing in the District. These systems are generating enough electricity to offset nearly 70% of the energy costs on an average home in DC.
Pollution	The level of air pollution has frequently exceeded recommended standards. Plenty of vehicular traffic and boon in construction could be the probable reasons.	In 1998 Beijing declared war on air pollution. The challenge was to find ways to improve air quality and it appears that Beijing is winning the battle. Air	Air pollution is cause due to major industrial sector. It causes illness related respiratory disorder. Poor drainage of waste water cause bad odour.	Washington just moved up on the most ozone-polluted cities list. In 2013, it ranked ninth; in 2012, it was 13th.

		quality has improved substantially.	industrial waste is also cause water pollution.	

Using such framework, the positives of a city, as well as negative urban issues in it can be swiftly identified. Based on the issues identified, the researchers, whether they are private entities or government authorities, can brainstorm and come up with possible solutions to resolve the issues sustainably.

After identification of issues in these cities, we have selected six urban issues for further analysis. After detailed discussion on these issues, we have presented one relevant case study of a city which has successfully mitigated the issue. The brief of case studies carried out on the basis of individual urban issues are as follows:

Urban feature and Issue	Relevant City, Mitigation measure adopted in city of case study
Industrial Area: Lack of space in city for industrial development	**Mumbai**: Mumbai city is known for its commercial growth all over the world. Due to less availabilty of land and major occupancy of commercial and residential sector, city faces the lack of space for industrial development. **Mitigation measure**: Due to unavailability of land use in industrial developments and densily populated region, government and MIDC decided to locate industrial area in cities of Navi Mumbai. Cities like Ghansoli,Rabale, Nerul, Taloja and major part in Turbhe contribute in the development of Industrial sector in Navi Mumbai under MIDC.
Open and Green Spaces: Lack of Green Spaces in urban areas	**Paris**: The city has instituted a range of greening initiatives to counter urban heat island effect. Two important initiatives are "Licence to Green" and Rooftop Farming.

	1. License to Green: Essentially, the programme is a license for citizens to 'vegetate as much as you want'. Citizens are now encouraged to plant trees and gardens on vacant pieces of land-anything from an unoccupied plot to a sidewalk on the street. 2. Rooftop Farms: As a law, vegetation must be planted on all new buildings, and soon the city will build 100 additional hectares of green roofs – one-third of which will be used for agriculture. In a rooftop farm, vertical farming is adopted, in which crops are grown efficiently in a limited space by stacking up cultivation spaces. Soon, the world's largest urban rooftop farm will open in Paris. The farm has an area of 14,000 square meters, where more than 30 types of plants can be grown. About 1,000kg of fruits and vegetables will be harvested daily during the high season. The Paris initiatives envision environmental, social and health benefits.
Culture: Neglect of Cultural and Historical Places in urban centers	**Beirut**: Beirut is one of the oldest cities in the world. Its Central District contains sites and monuments spanning over 5,000 years of civilization. In 1975, with the eruption of the Lebanese civil war, many historic places were either partially damaged or fully destructed. In the aftermath of the war, with an accumulation of crises and social conflicts and cultural community positions, it was necessary to rebuild. Reconstruction affected an area of about 1.8 million square meters. In the Beirut Central District, 265 ancient structures were renovated or reconstructed. These structures now continue to have pre-war themes, with most of them being emblematic fountains, souks, religious monuments, city gate stairs, etc. Most of the 265 buildings are concentrated in the historic centre, the Nijmeh square area.

Homelessness: A women's domestic violence service: Supported Accommodation and Homelessness Services Shoalhaven	**Illawarra, New South Wales Australia** Supported Accommodation and Homelessness Services Shoalhaven Illawarra (SAHSSI) is a Specialist Homelessness Service formed when Wollongong and Warilla Women's Refuges merged in late 2014. The agency is targeted to single women and women with children who are at risk of, or experiencing, homelessness.
Climate changes: Rehabilitation of a micro-central hydroelectric installation	**Nueva Alianza,Guatemala** 2008 Wisions Award Winner (Wuppertal Institute for Climate, Environment and energy)
Solid Waste Management: Insufficient resources and poor management	**Mumbai**: The current MSWM system in Maharashtra is acknowledged as highly inefficient, particularly in Mumbai. The rapidly increasing amounts of municipal solid waste being produced in combination with poor management planning and insufficient financial resources makes today's situation a severe problem. The problem with MSWM results in diverse negative impacts on the environment, human health, and safety that result in economic, environmental and biological losses . The shortcomings of the SWM thus contribute to serious environmental degradation and pollution. Mitigation measure: For a sustainable solution, a holistic approach is necessary. The MSWM system can be seen as a typical case of a sociotechnical system. Changes in such systems involve several actions in different areas (e.g. social, technical, financial, institutional) and on different levels in the

	society. To support the technical solutions, it is important to view the technical systems as a part of a bigger sociotechnical system and incorporate them with organizational and political solutions as well. Hence, participation from and interactions between different stakeholders and actors is absolutely necessary in order to develop support for policies. MSWM requires proper infrastructure and a well thought out urban planning.

These case studies contain innovative solutions for problems that are very common and relevant in today's urban environment. These solutions can very well be emulated on other cities facing the same issues.

Following are the benefits of developing this comparative framework:

1. This project will be helpful in better understanding growth patterns of cities across the world.

2. The drawbacks and benefits of the existing structures of the city can be useful for preparing guidelines for future city planning.

3. Effectiveness of initiatives taken in different cities across the world to mitigate urban planning issues can be compared.

4. The preparedness of the cities for future growth can be assessed.

5. Using this framework, the growth patterns of a city can be understood with greater clarity.

6. The sustainability and environment-friendliness of cities can be measured.

7. Modern techniques and ideas can be suggested for future development.

APPENDIX: LIST OF REFERENCES

JOURNAL PAPERS:

1) Doha Municipality (2014) Doha Municipality Vision and Development Strategy.
2) D.F. Harb (n.d.) Walk-ability Potential in The Built Environment of Doha City, Qatar University, Qatar
3) Shandas, V., Makido, Y. and Ferwati, S. (2017). Rapid Urban Growth and Land Use Patterns in Doha, Qatar: Opportunities for Sustainability? European Journal of Sustainable Development Research, 1(2), 11.
4) Florian WIEDMANN, Ashraf M. SALAMA, Alain THIERSTEIN (2012) *'URBAN EVOLUTION OF THE CITY OF DOHA: AN INVESTIGATION INTO THE IMPACT OF ECONOMIC TRANSFORMATIONS ON URBAN STRUCTURES*', Qatar University.
5) Hatem Galal A. Ibrahim (n.d.) 'A new paradigm of urban development: envisioning sustainable futures in Qatar', WIT Transactions on Ecology and The Environment, Vol 173, © 2013 WIT Available at: www.witpress.com (Accessed:)
6) Charfeddine Lanouar, Afnan Yousef Al-Malk, Khloud Al Karbi (2016) 'Air Pollution in Qatar: Causes and Challenges', College of Business and Economics, Qatar University White Paper Volume 1 No. 3 2016, 1(3), pp. 1-7. (2018) WATER STATISTICS, Doha: Planning and statistics Authority.
7) Colliers International (November 2014) Doha's Residential Market Market Performance, Trends and Affordability.
8) Khaled Shaaban, Essam Radwan (2014) *'Rebuilding the Transportation System in the City of Doha'*, Journal of Traffic and Logistics Engineering, 2(3).
9) Alan Meier, Sinan Sabeeh, Mohamed Darwish (2013) *'Complexities of saving energy in Qatar'*, ECEEE SUMMER STUDY proceedings.

10) London assembly 2018_environment_committee_-_waste_management_-_scoping_paper_ukgovernment (pdf).

11) londonwaterkeeper.org.uk/ report pollution water pollution report_assessment reports.

12) Gu Chaolin, Yuan Xiaohui and Guo Jing, China's master planning system in transition: case study of Beijing, 46th ISOCARP Congress 2010

13) Beijing Municipal Commission of Transport (https://web.archive.org/web/20080629012021/http://zw.bjjtw.gov.cn/english/)

14) International journal of Geo-information An Urban Road-Traffic Commuting Dynamics Study Based on Hotspot Clustering and a New Proposed Urban Commuting Electrostatics Model

15) Case Report: Analysis of Spatial Characteristics of Digital Signage in Beijing *Published: 6 May 2019 www.mdpi.com/journal/ijgi*

16) Challenges to Reducing Air Pollution in China amid Economic Slowdown
Author: Mun Ho and Chris Nielsen

An Overview of Sewage Treatment Rates in Chinese Cities

17) Dzivaidzo Mumbengegwi, Tianxin Li and Jean Pierre Muhoza
School of Civil and Environmental Engineering, University of Science and Technology Beijing, Beijing, China

www.uscc.gov>files PDF

18) Chapter 2 Beijing's Internal and External Challenges
Beijing: Industry, Economics, and Policy

Written by Zoey Ye Zhang (http://www.asiabriefifing.com/personnel/zoey-zhang.html)

19) The Climate Change, Water Crisis and Forest Ecosystem Services in Beijing, China
Zhang Biao Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Science, Beijing, China

20) The Governance of Environmental Issues at City Level of Beijing
Marie Pla & Jérôme Douaud, for Urbanistes du Monde September 2015

21) Climate Change Mitigation in Beijing, China
Jimin Zhao Case study prepared for Cities and Climate Change: Global Report on Human Settlements 2011 Available from http://www.unhabitat.org/grhs/2011.

22) Sierra, L.A.; Yepes, V.; Pellicer, E. A review of multi-criteria assessment of the social sustainability of infrastructures. J. Clean. Prod. 2018, 187, 496–513.

23) Wong, J.K.W.; Zhou, J. Enhancing environmental sustainability over building life cycles through green BIM: A review. Autom. Constr. 2015, 57, 156–165.

24) Fercoq, A.; Lamouri, S.; Carbone, V. Lean/Green integration focused on waste reduction techniques. J. Clean. Prod. 2016, 137, 567–578.

25) LEED. LEED Reference Guide for Green Building Design and Construction; United States Green Building Council Institute: Washington, DC, USA, 2009.

26) Kieu, L.M.; Bhaskar, A.; Chung, E. Passenger segmentation using smart card data. IEEE Trans. Intell.Transp. Syst. 2015,16, 1537–1548.

27) Janoska, Z.; Dvorský, J. P system based model of passenger flow in public transportation systems: A case study of prague metro. Dateso 2013,2013, 59–69.

28) Celikoglu, H.B.; Cigizoglu, H.K. Public transportation trip flow modeling with generalized regression neural networks. Adv. Eng. Softw 2007,38, 71–79.

29) Okutani, I.; Stephanedes, Y.J. Dynamic prediction of traffic volume through Kalman filtering theory.Transp. Res. Part B Methodol. 1984,18, 1–11

30) WHO Regional Office for Europe (2017) Urban green spaces: a brief for action, Copenhagen, Denmark

31) Diogo Guedes Vidal, Nelson Barros and Rui Leandro Maia (n.d.) 'Public and Green Spaces in the Context of Sustainable Development'

32) Agudelo-Vera, C., Mels, A., Keesman, K., & Rijnaarts, H. (2011). Resource management as a key factor for sustainable urban planning. Journal of Environmental Management, 92, 2295-2303

33) BBC. (2016, February 25). What is India's caste system? Retrieved 05 25, 2016, from http://www.bbc.com/news/world-asia-india-35650616

34) Bhada, P., & Themelis, N. (2008). Potential for the first WTE facility in Mumbai (Bombay) India.

35) Chatri, A., & Aziz, A. (2012). Public Private Partnerships in Solid Waste Management: Potential and Strategies. Athena Infonomics.

36) Debnath, S., & Bose, S. (2014). *Exploring full cost accounting approach to evaluate cost of MSW services in India. Resources*, Conservation and Recycling, 83, 87-95.

37) Epstein, M., & Buhovac, R. (2014). *Making sustainability work – Best practices in managing and measuring corporate social, environmental and economic impacts* (Vol. 2nd edition).

38) UNDP - United Nations Development Programme. (2016). Sustainable Development Goals (SDGs). Retrieved 05 22, 2016, from

39) UNEP - United Nations Environment Programme. (2005). Solid Waste Management. CalRecovery.Zhu, D., Asnani, P., Zurbrügg, C., Anapolsky, S., & Mani, S. (2008).

40) Municipal Solid Waste Management in India: A Sourcebook for Policy Makers and Practitioners.Washington, D.C.: The World Bank.

41) Government of Maharashtra (1998) Modifications of Industrial Location Policy in Mumbai Metropolitan region Government Resolution, Government of Maharashtra, Mumbai.

42) MMRDA (1996) Regional Plan for Mumbai Metropolitan Region 1996-2011, Mumbai Metropolitan Region Development Authority, Mumbai.

43) Siame -Hanna Ishac (2017) *'ICOA1947: RECONSTRUCTION OF BEIRUT LEBANON: CHALLENGES IDENTITIES RECONCILIATION AND MODELS'*

44) *NANCY DUXBURY JYOTI HOSAGRAHAR JORDI PASCUAL* (January 2016) Why must culture be at the heart of sustainable urban development?:The Committee on culture of the world association of United Cities and Local Governments (UCLG).

45) UNESCO (31 May 2015) HABITAT III ISSUE PAPERS 4 – URBAN CULTURE AND HERITAGE, New York

WEBSITES:

https://www.iloveqatar.net/guide/places/ten-beautiful-parks-to-visit-in-qatar

https://www.railway-technology.com/projects/doha-metro/

https://www.thepeninsulaqatar.com/article/21/09/2019/Qatar-makes-great-efforts-in-addressing-climate-change#:~:text=Among%20the%20efforts%20of%20Qatar,natural%20gas%20fuel%20to%20reduce

https://www.ecomena.org/solid-waste-management-in-qatar/

http://www.mme.gov.qa/QatarMasterPlan/English/msdp-zoning.aspx?panel=about

https://www.london.gov.uk/sites/default/files/housing_in_london_2015

https://www.theguardian.com/society/2019/dec/18/homeless-households-in-england-up-by-23-in-a-year-official-figures

https://www.ukpopulation.org/london-population

https://www.expatarrivals.com/europe/united-kingdom/london/education-and-schools-london

https://www.architectureartdesigns.com/londons-architectural-styles

https://www.london.ca/residents/Water/Water-System/Pages/Water-Quailty.aspx

https://www.researchgate.net/publication/319623260_Water_supply_and_sanitation_services_in_modern_Europe_developments_in_19th-20th_centuries

http://www.london.ca/residents/Garbage-Recycling/Garbage/Documents/The_Story_of_W12A.pdf

https://www.londonwaterkeeper.org.uk/reportpollution

https://City of London smart city initiative (smart-energy.com)

https://www.gov.cn/english/ https://chinafolio.com/provinces/beijing/

http://beijing.china.org.cn/2012-12/18/content_27449920.htm

http://www.chinatoday.com/city/beijing.h

tm

https://www.thebeijinger.com/blog/2016/05/09/beijings-best-urban-green-spaces-make-most-spring

http://www.china.org.cn/english/government/71406.htm

https://www.china-briefing.com/news/

https://en.m.wikipedia.org/wiki/Chinese_architecture

http://www.beijingrelocation.com/blog/remarkable-green-buildings-in-beijing/ https://jingdaily.com/high-end-mall-beijing-oldest-shopping-district/ h

www.chinahighlights.com/travelguide/architecture/ttps://

https://www.tour-beijing.com/sport/#.X04-nXXhWNw https://www.thoughtco.com/modern-architecture-beijing-china-4065221

https://www.statista.com/statistics/990545/china-population-distribution-by-age-group-in-beijing/ https://www.google.com/amp/s/www.ceicdata.com/en/china/electricity-consumption/cn-electricity-consumption- beijing/amp

https://theculturetrip.com/asia/china/articles/the-most-scenic-spots-in-beijing/

Maharashtra Industrial Development Corporation - Wikipedia

https://livingroofs.org/paris-licenses-citizen-gardeners/

https://www.c40.org/case_studies/cities100-paris-green-spaces-keep-the-city-cool

https://amp.theguardian.com/cities/2019/aug/13/worlds-largest-urban-farm-to-open-on-a-paris-rooftop

https://www.nytimes.com/2019/12/06/t-magazine/paris-rooftop-garden.html

https://api.nationalgeographic.com/distribution/public/amp/travel/destinations/asia/lebanon/beirut-war-damaged-landmarks-becoming-cultural-sites

https://14x1z243z988315lc25fjqzl-wpengine.netdna-ssl.com/wp-content/uploads/2017/10/dcdr_2019.pdf

https://londonist.com/2016/09/the-5-big-problems-in-london-and-the-people-doing-something-about-them

https://www.urban.org/sites/default/files/publication/51666/311218-City-Government-s-Role-in-the-Community-Dehttps://www.tripsavvy.com/amusement-parks-near-dc-4066921

https://www.dcwater.com/dc-water-glance

https://cfo.dc.gov/page/unified-economic-development-reports

https://www.trolleytours.com/washington-dc/history

https://doee.dc.gov/service/green-buildings

https://www.urban.org/sites/default/files/publication/51666/311218-City-Government-s-Role-in-the-Community-Development-System.PDF

https://www.epa.gov/sites/production/files/2017-05/documents/signed_-_letter_-_municipal_solid_waste_landfills.pdf

https://www.csu.edu/cerc/researchreports/documents/ManagingAmericasSolidWaste1998.pdf

https://journals.sagepub.com/doi/pdf/10.1177/0734242X9100900102

https://www.researchgate.net/publication/326888027_Towards_a_Better_Understanding_of_Public_Transportation_Traffic_A_Case_Study_of_the_Washington_DC_Metro