

# *(Sustainability of urban planning in smart cities through compatible infrastructure Towards a Better Quality of life)*

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*Abstract*— Infrastructure is the foundation of sustainable development. It includes the integration of all economic, social and political activities in various urban societies. It is the lifeblood and spine without which there can be no development or cultural welfare in society. It works to improve the living conditions of individuals by providing physical and social services, employment opportunities and attracting foreign investment and encouraging the private sector to invest in various infrastructure projects. The main objective of this research is to highlight the importance of infrastructure in line with the safety and well-being of its population and to connect the infrastructure and make it compatible with sustainable urbanization to achieve sustainability, to reach sustainable smart cities. To achieve this, the research analyses the principles and objectives of sustainable development, linking them to the infrastructure and how to achieve them in order to achieve sustainable cities that achieve their quality of life. Research depends on the descriptive and analytical approach. The theoretical part covers the concepts of infrastructure and sustainable development, smart cities and quality of life and their importance. In the comparative analysis, the research shows the characteristics of infrastructure development in cities through the use of advanced technology and its relationship to sustainable environmental development to obtain the foundations and principles that can be applied to the new intelligent infrastructure to measure the sustainability and quality of infrastructure, and how to meet the needs of individuals for better quality of life. Conclusions from this research will be drawn with recommendations. Keywords compatible infrastructure; sustainability; smart cities; sustainable urbanization

## **I. INTRODUCTION**

The infrastructure is anything needed for daily life, everything is used on a daily basis, and it represents the backbone and lifeline of all economic, social and political life activities. Infrastructure plays an important role in society, without them there can be no development or cultural well-being in society.

We find that infrastructure in different Arab countries suffers from inefficiency and waste of natural resources and not to benefit from sustainable planning.

## **Research problem**

The infrastructure suffers from non-application of the principles and objectives of sustainability and compatibility with the environment and consumption of environmental resources and dependence on traditional methods and affects negatively on the city, population, individuals and future generations .

## **Research goal**

Know the basics and principles that can be applied to infrastructure for sustainable infrastructure, within environmentally sound cities with better quality of life for individuals.

## **Hypothesis Research**

Using sustainable infrastructure work to achieve a better quality of life

## **II. THE CONCEPT OF THE INFRASTRUCTURE**

Are the organizational structures necessary for the functioning of society or project or services and facilities necessary for the functioning of the economy they can generally be defined as a set of interrelated structural elements that provide a framework that supports the overall structure of development they represent an important term for judging the development of the State or region.

Fulmer is known as the technical infrastructure that supports the community such as water resources, sanitation, electrical networks, and telecommunication, which are the physical components of the interconnected systems, which provide the necessary goods and services necessary to enable or sustain and improve the conditions of the community life [3]. The infrastructure supporting human activities includes complex and interrelated physical, social, ecological, economic, and technological systems such as transportation and energy production and distribution; water resources management; waste management; facilities supporting urban

and rural communities; communications; sustainable resources development; and environmental protection (American Society of Civil Engineers 2009, ).

Social organizations have defined infrastructure as an invisible backbone to support the natural, cultural and technological environment necessary for the development of the city [2]. When viewed in terms of functionality, the infrastructure facilitates the production of goods and services, Product distribution in markets, In addition to basic social services, Such as schools and hospitals, they provide the ability to transport raw materials to factories.

### A. Infrastructure elements

The infrastructure is the basis on which the functional performance in the city, which is important for the city's development and development there are three main elements are water, electricity, sanitation

- Social elements: It includes hospitals, popular clinics, fire and education centers, schools, universities, and other services.
- Physical elements: These include water treatment systems, road bridges and transportation lines for power plants. Sewage system, as well as seaports and airports.
- Sustainability of water: Preserve water and reduce its use. Joint use. Recycling of water. Development on the infrastructure. Water balance of the project It is an integrated step to develop a water management plan, Balancing between water supply and demand By relying on diverse sources of water, as well as rationalization of water consumption.
- The electricity grid: is the basic structure of human activity, Providing electricity sources works to improve the population-environment, With economic and social impact, Traditional electric energy is an important and fundamental element in the operation of infrastructure, The design and the energy system depend on the level of demand and its ability to meet the needs, Consumption varies according to the activities used. Diversity of energy sources based on climate, technology, and resource availability, Depending on the oil in the production of electric energy, With technological development and other technologically advanced sources of energy, Including gas and nuclear power, With the negative effects of these sources, the trend was to use sources of energy that are not polluted to the environment depending on the sun and wind ,It is considered a sustainable source of energy production.

Sanitary drainage: This sector does not meet the needs as a result of increased population, for progress this sector improve old networks and create them to achieve the best performance possible for the city system. Remove all excesses and illegal connections to the network. Separation of drainage networks and rainwater drainage networks. Treatment of wastewater

and reuse in recreational uses in the city, industry, agriculture, and groundwater recharge Fig.1.

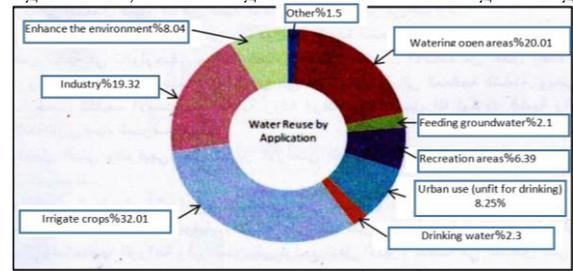


Fig. 1. The percentage of re-use of sewage water around the world 2010[4].

Percentage of investment in infrastructure in the GCC countries for years 2015–2010

country	Billion dollar	%
United Arab Emirates	230	23.4
Bahrain	25	2.5
Saudi	405	41.1
Oman	80	8.1
Diameter	135	13.7
Kuwait	110	11.2
Total	985	100

Fig. 2. The size of the Gulf countries' spending on infrastructure projects up to 2010 [5].

### B. Objectives of sustainability of infrastructure

Sustainability of infrastructure has many objectives:

#### 1) Health and quality of life development:

- Providing the population with drinking water.
- Improving public services.
- Rational planning of household solid waste and hazardous waste.
- Fighting industrial pollution.
- Improve air quality in cities.
- Strengthening environmental governance.
- Improving the environmental planning of cities.
- The increase in the area of vegetables and the protection of cultural heritage.

#### 2) Conservation and improvement of natural resources:

- Improve land use and combat desertification.
- Rational planning of irrigation water.
- Conservation of biodiversity.
- Preservation of oases.

#### 3) Reducing economic losses:

- Rational planning of water resources.
- Increase in waste recycling and recovery of raw materials.

- Improving the effectiveness of the port activity.
- Converting or closing public institutions that are more polluted and less profitable.

4) *Protection of the overall environment:*

- *Increased vegetation cover, density, and biodiversity*
- Increase in protected areas, wet zone.
- Protection of oases from household wastes and salinity.
- Reducing greenhouse gas emissions that contribute to global warming, especially from the oil sector.
- Eliminate materials that weaken the weight layer.

### III. SUSTAINABLE DEVELOPMENT

The International Union for the Conservation of Natural Resources for Sustainable Development was recognized, it is the constant pursuit of the development of human life, taking into consideration the capabilities of an ecosystem that preserves life [5]. Sustainable development is defined in its comprehensive and general sense as a comprehensive activity for all sectors, whether in the State, the organizations, public or private institutions or even individuals. The process of developing and improving the conditions of reality is through study of the past, learning from its experiences, Change it for the better, and plan well for the future by optimizing the resources and human and material resources, including the information, data and knowledge possessed by the evaluators in the development process, while maintaining absolute faith in the importance of continuous learning, Development on one side or just one area of life domains is not limited, but include social, economic, political, military, humanitarian, psychological, mental, medical, educational, technical and other development, so that primarily aims to raise and improve the standard of living of individuals, and to ensure a better standard of living for future generations[6].

#### A. *Dimensions of sustainability:*

1) *Environmental dimension: Is interested in achieving ecological balance, preserving the natural environment, built environment through Integration of ecosystems, biodiversity, and conservation of natural resources within their capacity to absorb them.*

2) *Social dimension: It is concerned with achieving the social and stable empowerment of different human societies and enhancing social participation, delegating powers and social mobility and achieving equality in distribution.*

3) *Economic dimension: It is concerned with achieving economic development, increasing productivity and achieving efficient economic performance, to achieve sustainable growth and satisfaction of basic needs to achieve economic justice.*

#### B. *Foundations and principles that achieve sustainability[12]:*

- Reduce depletion of natural resources.

- Meet the needs of the present without compromising the capabilities of future generations to meet their needs.
- Integration of social, economic, technological and environmental aspects.
- Use of scientific progress in the investment of environmental resources and solve their problems.
- Its continuity and its environment and ecosystem.
- Continuity improvement of living standards for individuals.
- Selection of technical means with limited residues.
- Reliance on recycled material.
- Rationalization and a good selection of industrial zones.
- Maintain the balance between available materials and basic needs over the long term.
- Develop development plans for natural resources so that justice is achieved between generations.
- Achieving equality and social justice.
- Maintenance by putting an end to uses that wastewater and improve the efficiency of networks.
- Protecting the climate from global warming.
- Integration of planning with the characteristics of environmental sites.
- Investment in human capital.
- Securing the basic needs of the population.
- Popular participation.
- Stabilize demographic growth and make it balanced with economic growth.
- Achieving equality in distribution and combating poverty.
- Achieve sustainable economic growth.
- Changing unsustainable patterns of production and consumption
- Use cleaner technology in industrial facilities.
- Preventing the deterioration of the ozone layer

### IV. SMART CITY

Smart City is defined as a city that works in an ambitious and innovative manner that covers the economy, population, governance, and mobility. Environment and innovation. This innovation is based on a clever mix of support and active participation of independent and conscious citizens who are able to make decisions [9]. The characteristics of smart cities are related to the use of IT technologies, and they are characterized by [10]:

**A. Entelligent Movement / Intelligent Transfer:**

The management of the transport and traffic system through the group of technologies that rely on information technology and can replace the smart movement with the infrastructure of smart and sustainable and therefore the shift towards the sustainability of infrastructure is the basis for the transition to the sustainability of the city and described in the Green City. The following is a presentation of the components of the infrastructure of the city (energy - Solid waste) and their transformation into environmentally sustainable elements and the extent to which information technology is used for sustainability[11]:

1) *Renewable energy: Green cities reduce the use of non-renewable energies to their lowest levels using renewable energy such as solar Fig.3. Solar Panels in Daggett, California, wind, underground energy and water power and increase their utilization rates at the city level. This has also led to the development of ways to reduce energy consumption at the building level Fig.5. Dependence on oil is essentially a source of energy and little reliance is shown on clean energy sources for the environment or to illuminate the roads and traffic within the city from solar PV. Renewable energy sources Wind power Solar thermal PV solar energy Water power and use as clean power plants for the city Fig.4.*

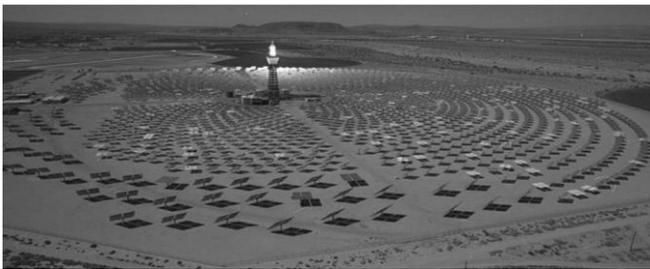


Fig. 3. Water use in the USA in 2000[15].



Fig. 4. Renewable energy sources and use as clean power plants for the city[13].

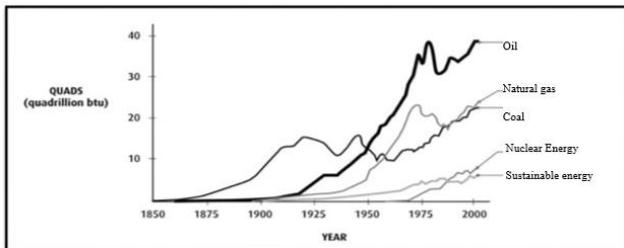


Fig. 5. The combination of means of energy and continue development[14].

2) *Water and Sanitation: Reducing energy consumption has not only been a sustainable component of the city but has also reduced water consumption and recycling. Information technology has produced many applications that have contributed to the conservation of natural water resources to ensure its sustainability. Including in the recycling of sewage Fig.6*

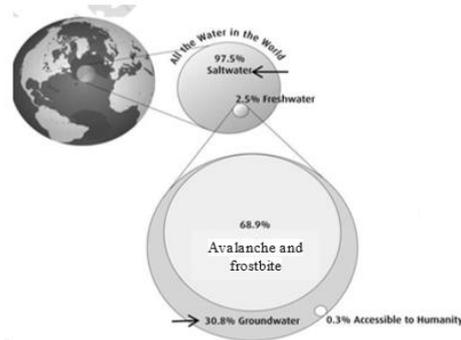


Fig. 6. Water sources in the ground ball and their proportions [13].

3) *Solid Waste Recycling Solid waste is one of the most important contaminants in cities, so its development is one of the most important criteria for the sustainability of the city and its transformation into a green city in a way that transforms it from a major contaminant into a source of energy.*

4) *Green transportation means the use of clean transportation, powered by electricity or solar energy while minimizing the traditional means of transport. In case of unavailability, the Green City works to reduce emissions by rationalizing its use by investing in public transport and reducing of the use of private transport illustrates the figure (green transportation)FIG.7,8.*



Fig. 7. Green and clean transportation[11].



Fig. 8. Green and clean transportation[11].

5) The physical city and the infrastructure included in it such as roads, buildings, localities, schools, hospitals and public places, and all that can exist in the environment of the city of the main components in the system of smart city, the strategy required to develop the city is determined by the interest of energy and infrastructure, Emphasis is placed on environmentally efficient transport and the provision of goods and buildings free from hazardous materials. Emphasis is placed on the use of sustainable energy and the sustainable use of land and water, In the United States, 80% of fresh water is used in agriculture and electricity, while general uses use 14% and industry only uses 6% Fig.9. Including the treatment of waste with minimal environmental impact [8]. There are four basic elements available in the Smart City which are necessary and general [9]:

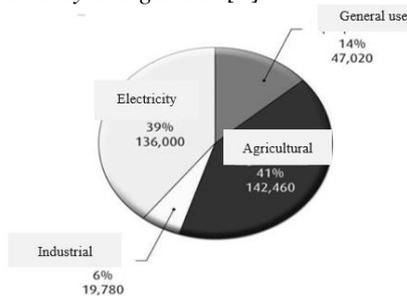


Fig. 9. Water use in the USA in 2000[15].

1) Effective use of physical infrastructure networks to improve the economy and effective policies to enable urban, social and cultural development

2) Making use of the available opportunities and having a strategic vision

3) Inter-sectoral participation

4) The ability to sustain

There are six basic dimensions recognized and adopted pillars for the development of the smart city [9]:

- Smart economy (competitive)
- Smart people (human and social capital)
- Intelligent governance (Participation)
- Smart mobility
- Smart environment ( Natural Resources)
- Smart Living Quality Life

## V. QUALITY LIFE

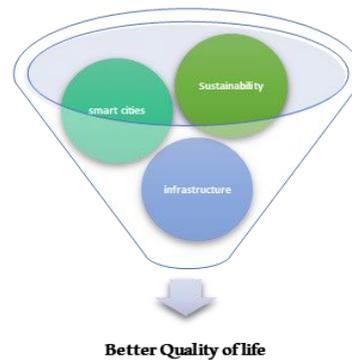


Fig. 10. Sustainable, smart cities, infrastructure give us a better quality of life.

## VI. Methodology

The research relies on two approaches: theoretical theory of research concepts and analytical approaches to try to connect the three components (sustainability, infrastructure, smart cities) and compare them to help achieve a better quality of life. The methodology underlying the research is to achieve the quality of life by taking three axes respectively namely:

- The first axis of sustainability.
- The second axis: infrastructure.
- Axis III Smart Cities.

Sustainability is the goal of sustainable development, which is evident through the United Nations indicators, which aims at helping to arrive at a set of indicators related to the second axis (infrastructure) and how to achieve its sustainability by way of comparison with the indicators of the first axis down to the third axis smart cities, which depends on the intermediate interface To be sustainable and from these three axes we get the quality of life for individuals within the city Fig.11.,12 .

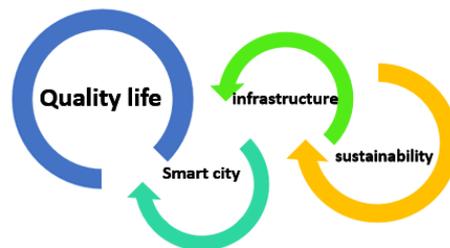


Fig. 11. three axes to great quality of life for individuals within the city.

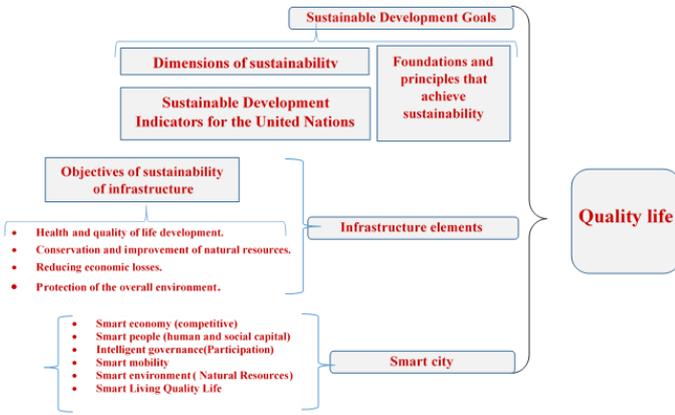


Fig. 12. Methodology Author .

**A. Sustainable Development Indicators for the United Nations.**

Sustainable Development Indicators for the United Nations in 2007, these indicators cover the problems and difficulties facing the world, its aim is to provide tools used by countries to help them reach sustainable development were divided into main and branch indicators and the extraction of indicators that serve the field of urbanization table I [7].

	The main indicator	Sub - indicators
1	poverty	Income poverty
		The unfair distribution of income
		Health facilities
		drinking water
		Access to energy
		Conditions of living
2	Governance	Corruption the crime
3	health	Deaths
		Provide health services
		Status of nutrition
		Health condition and risks
4	Fresh water	Quantity of water
		Water quality
5	Bio-diversity	Dynamic system
		Categories of living organisms
		Efficient performance of the general economy
6	economical development	Sustainable public finance
		Functions
		Communication and Information Technology
		Scientific research and development
		Tourism
7	Global Economoc Partnership	Trading
		Foreign Finance
8	Consumption and Production Patterns Materia	Consumption of materials
		Energy use
		Waste management and management
		Management of radioactive waste
9	Earth	Transportation
		State of the Earth and its uses
		Desertification
		Agriculture
		Forestry
10	Ocean Seas,	Beach areas

	The main indicator	Sub - indicators
	Beaches	Fishing
		Marine Environment
11	Education	Illiteracy education level
12	Population	Citizens
		Tourists
13	Natural hazards	Risk tolerance
		Preparedness and response to disasters weather changes
14	Atmosphere	The erosion of the ozone layer
		Air quality
		Population growth rate
15	demographics	The above percentage
		The proportion of the local population to the proportion of tourists

Indicators of infrastructure that can be derived from the United Nations indicators table II [Author].

	The main indicator	Indicators of infrastructure
1	poverty	Achieve equal distribution and fight poverty
		Provision of utility networks to serve all individuals
		Providing poor areas with water networks
		Share of poor households in energy or electricity sources
		Improving the standard of living of individuals
2	Governance	
3	health	Access to and provision of health services
4	Fresh water	Provision of feeding stations and water treatment
		Maintenance and put an end to the uses of wasted water and improve the efficiency of networks
5	Bio-diversity	Sustainability of the environment and the environment
6	economical development	Use communication and information to connect items
		Use early detection of hazards and problems before they occur
		Continuous scientific research to find out the latest developments in relation to the development of the infrastructure
		Contribute to attract and develop tourism
		Use communication and information to connect items
		Use early detection of hazards and problems before they occur
7	Global Economoc Partnership	Take advantage of the experiences of neighboring countries and share with them
8	Consumption and Production Patterns Materia	Conservation of environmental resources
		Use alternatives to sustainable energy, clean and maintain the environment
		Disposal of waste in the infrastructure in modern and safe ways
		Recycling and utilization of outputs
9	Earth	Taking into consideration the geology of the soil
		Good distribution during planning
		Strengthening the link between transport and land use
		Activate urban planning methods and organize transportation
		The existence of networks of ports
		Activating tourism and providing

	The main indicator	Indicators of infrastructure
		comfort for tourists
١٢	Population	Addressing the risks of floods, floods and rain Create a subnet that is capable of facing risks
١٣	Natural hazards	Reduce greenhouse gas emissions and mitigate the impact of climate change
١٤	Atmosphere	Providing afforestation and treatments to eliminate the pollutants of air pollution to obtain the quality of air Activating tourism and providing comfort for tourists
١٥	demographics	Addressing the risks of floods, floods and rain Create a subnet that is capable of facing risks

marketing of sustainable mobility solutions in the future.Fig.12.13.14.



Fig. 13. Water Networks, Transfer Schem..

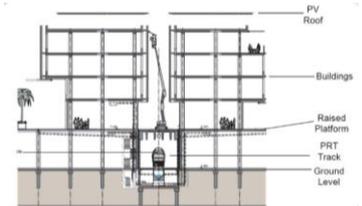


Fig. 14. The sector shows the infrastructure.

### B. Models for cities have achieved sustainability of the infrastructure

#### 1) Masdar city

combines the latest technological features and the principles of planning traditional Arab communities to create a desert society aimed at, Carbon Equalizer, Lack of waste, Encourage the implementation of renewable energy and clean technology solutions to create lifestyles that do not depend on the use of petroleum, Introduce new ideas for energy production and implementation, Target attracting the highest levels of experience, The city includes a number of public services including power, cooling and water supply, water areas and facilities (drinking water, dams, refined water and rainwater), communication and waste management, and infrastructure projects in the city will include planning and construction of parks, public squares, recreation areas, corridors and bridges for tunnels and technical services Information and communication in addition to managing project development [16].

Infrastructure: Strategically located in Abu Dhabi's transportation infrastructure, it is linked to neighboring communities and the international airport through the current route and train tracks. The city itself will be the first modern community in the world to operate without fossil fuel vehicles at the street level. With a maximum distance of 200 meters to the nearest high-speed transport links and leisure facilities. The city is designed to promote a culture of walking while shaded streets and pavilions provide an attractive pedestrian environment, protected from climate variability. The Fast Personal Transport System Network: operates without electricity and without the driver, which runs between the northern parking lot and the entrance to Masdar City, the first of its kind in the world. Since its launch in November 2010, the system has managed to transport more than 2 million people and a total distance to reach the moon and return and circulate around the Earth 5 times. The system has provided a tremendous amount of practical data to contribute to the

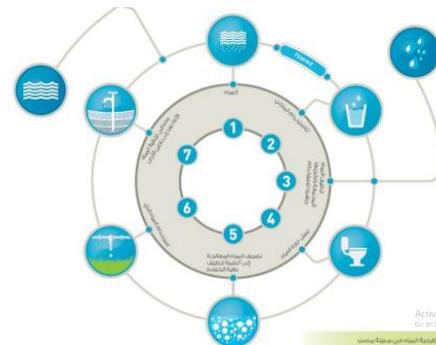


Fig. 15. Water Strategy in Source City.

#### a) Roads and Transport (Traffic Blanks)

Unlike other cities, the city of Masdar provides innovative solutions in the transport sector that will significantly reduce the impact on the environment without at the expense of ease of movement and movement. It will prevent vehicular traffic within the city. By means of a public mass transit system, by means of rapid, private transport, road and railways connecting the city with other areas.



Fig. 16. The Basic form of private transport vehicles, Friendly trains[19].

The city will be car-free and contain only pedestrian corridors, which are not far from the nearest station or

200 public facilities. This network encourages residents and visitors to walk and strengthen relationships. Energies Fig.16.

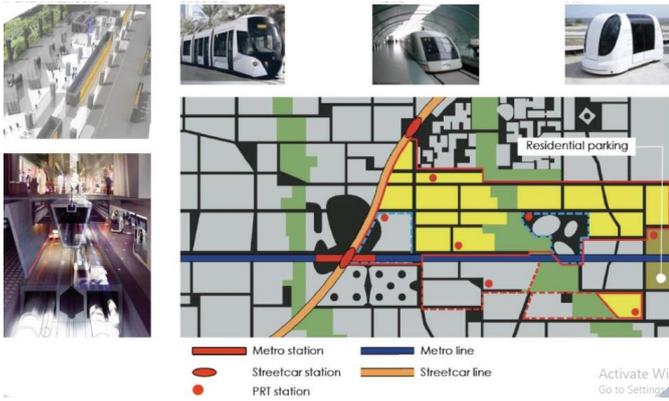


Fig. 17. The method used to distribute public and private transport[19].

b) Wind Energy:

The surrounding area will include wind and solar wind farms, fields and research farms, allowing the city's community to achieve energy self-sufficiency, outside the vicinity of the city, wind speed farms capable of producing 20 megawatts will be built. The traditional architecture of the Gulf will also be used to create low-energy buildings, Fig.14.

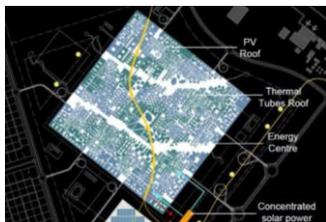


Fig. 18. Energy supply plan[17].



Fig. 19. Use large surfaces of solar cells[19].



Fig. 20. Wind farms on the borders of the city[19].

c) Waste

Masdar City is a sustainable model through the application of technologies and best practices to reduce energy and water consumption, reduce waste and reduce carbon emissions, The city will try to reduce the waste to zero, waste treatments will be used to obtain soil and fertilizer, and some of these waste can be converted into an additional source of energy. Industrial waste, such as plastics, will be recycled or reused for other purposes. To achieve these goals, Masdar Institute for Science and Technology and its headquarters within the city will assist in research and studies in this field, As a result of the use of these techniques Fig15 [18]

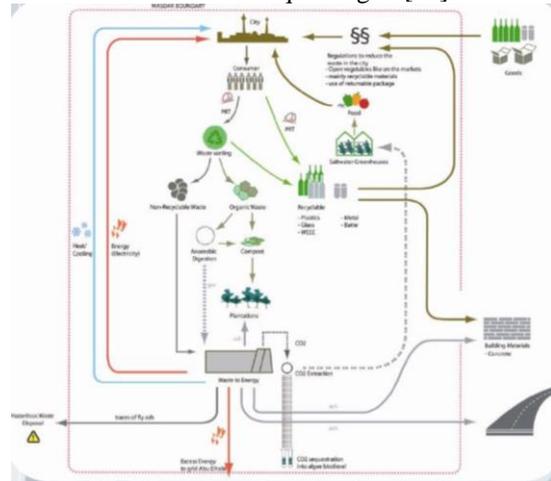


Fig. 21. Waste management scheme {19}.

The city will witness unprecedented levels of demand for electricity, including energy, water, and waste dumps, which will see a 75% drop in electricity needs. Masdar City will need about 200 megawatts of clean energy compared to more than 800 megawatts for a traditional city of the same size. It will also see a decrease in water consumption by more than half, where the city will need about 8000 cubic meters of desalinated water per day compared to more than 20,000 cubic meters per day for a traditional city. There is also no need for landfills, as the traditional city of this size needs dumps of millions of square meters FIG.16.



Fig. 22. Waste management scheme.

## VII. CONCLUSION

One of the goals of sustainability in smart cities is to achieve a sustainable infrastructure that meets the needs of individuals and achieves a better quality of life. The infrastructure is important for the development and construction of cities in terms of the environment, as it contributes to creating a healthy environment that contributes to the daily activity of the community members, employment and living, and affect the quality of life in the city.

Quality of life works on:

- increase production
- Increasing national production
- Increase national income
- Increase income for individuals
- Quality of nutrition

Infrastructure is an essential element of the city and depends on its growth and development. It is an integrated and continuous system that deals with inputs and outputs among them. The objectives of sustainability are to maintain the ratio and provide a healthy environment for the community and economic efficiency by reducing pressure on natural resources and the search for sustainable sources in the provision of water, electricity, sanitation, economic efficiency, and cost.

## VIII. RECOMMENDATIONS

- Educate citizens and society the importance of rationalization and AI knowledge of the risks of energy, water, infrastructure, waste and its impact on future generations through educational courses and seminars, as well as providing students with adequate training on the stages of rational use of infrastructure
- Diversity in finding alternatives to energy and directly involving the private sector, providing incentives and support.
- To move towards the desert to establish solar farms and windmills and produce clean energy and connect them to the national grid.
- Provide separate rainwater networks linked to reservoirs for collection and use as raw material for multiple uses. Reliance on new sources of water such as groundwater, rainwater and reuse of wastewater after treatment.

- Increasing the number of sewage treatment plants for the purpose of recycling water more efficiently and benefiting from clean water.
- The use of modern technologies and smart in the conservation of energy and water and the distribution of the state of these techniques to families to be more comprehensive and comprehensive.

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