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Towards a sustainable Urban Development: A Study of Smart City Strategies and their applications on the New city of Hassi Messaoud

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Dedications

First and foremost, I would like to express my gratitude to Allah for His guidance and blessings that have accompanied me throughout this academic journey. Praise be to Allah.

I dedicate this thesis to my late father; in whose loving memory I will always be grateful for the morals he taught me.

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Abstract:

Through this study, we seek to explore the dimensions and components of smart cities as well as to analyze successful strategies for smart city models in the world. We relied on SWOT analysis to assess each strategy's strengths, weaknesses, opportunities, and threats. We are bearing in mind that the results obtained will help to develop a smart city strategy and build on the new city of Hassi Messaoud as a case study to turn it into a smart city, providing guidance to policymakers, urban planners, and stakeholders involved in developing the new town of Hassi Messaoud and similar emerging urban centers.

Keywords: Sustainable cities, smart cities, smart city strategies, new town Hassi Messaoud.

خلاصة:

نسعى من خلال هذه الدراسة الى استكشاف أبعاد ومكونات المدن الذكية بالإضافة الى تحليل الاستراتيجيات الناجحة لنماذج المدن الذكية في العالم، حيث اعتمدنا على تحليل SWOT لتقييم نقاط القوة والضعف والفرص والتهديدات المرتبطة بكل استراتيجية. مع اخذ بعين الاعتبار ان النتائج المتحصل عليها ستساعد في وضع استراتيجية للمدن الذكية وبالاعتماد على مدينة حاسي مسعود الجديدة كدراسة حالة لتحويلها إلى مدينة ذكية، حيث توفر التوجيه لواضعي السياسات والمخططين الحضريين وأصحاب المصلحة المشاركين في تطوير حاسي مسعود والمراكز الحضرية الناشئة المماثلة.

الكلمات المفتاحية: المدن المستدامة، المدن الذكية، استراتيجيات المدن الذكية، المدينة الجديدة حاسي مسعود.

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General Introduction

A. General Introduction:

The world is experiencing the fastest rate of urbanization in the 21st century. As populations gather in cities at an increasing rate, the need for sustainable efficient urban environments has become important. In reaction to this challenge, the concept of smart cities was born as an innovative approach to changing urban living's future. (Smart Cities Unleashed: Pioneering the Future of Urban Living, 2023)

A smart city represents a paradigm shift in urban development, intertwining technology, data, and connectivity to create intelligent and responsive urban ecosystems. (Redefining the Future of Urban Living: The Newest Smart City Projects from Across the Globe, 2023) It is making use of innovative technologies like the Internet of Things (IoT), artificial intelligence (AI), big data analytics, and renewable energy sources to reduce the use of resources and increase the quality of life, and overall well-being of its residents. The concept of connection is at the center of a smart city. Cities may collect real-time data on many elements such as energy consumption, traffic patterns, waste management, and environmental conditions by creating a network of sensors and devices throughout the urban landscape. This many of data helps city managers to make data-driven decisions, discover inefficiencies, and adopt targeted solutions to improve urban services and infrastructure. Improving sustainability is one of the key goals of a smart city. By integrating sustainable practices, such as energy-efficient buildings, smart grid systems, and renewable energy generation, smart cities strive to reduce their carbon footprint and minimize environmental impact (Smart Cities Unleashed: Pioneering the Future of Urban Living, 2023). They promote eco-friendly transportation options, prioritize green spaces, and encourage the adoption of sustainable lifestyles among residents.

Besides environmental sustainability, smart cities focus on their citizens' health and quality of life. They encourage engaged participation, collaboration, and inclusivity through smart governance and citizen engagement projects. Smart cities promote the provision of efficient and accessible public services, such as smart healthcare systems, intelligent transportation networks, and digitalized government services, in order to successfully meet the needs of its citizens. (Redefining the Future of Urban Living: The Newest Smart City Projects from Across the Globe, 2023)

While the concept of smart cities holds immense promise, it also presents complex challenges. Privacy and data security concerns arise from the vast amount of personal information collected by smart city systems. Infrastructure development, technological interoperability, and financing are among the practical considerations that require careful planning and collaboration. Moreover, the equitable distribution of smart city benefits across different socioeconomic groups and the digital divide are vital issues that demand attention. we will set the stage for a comprehensive exploration of smart cities, delving into the underlying principles, key components, and transformative potentials they offer and the strategies that use worldwide. By analyzing successful case studies, emerging trends, and the implications of smart city development, this research aims to provide valuable insights and recommendations for policymakers, urban planners, and stakeholders involved in shaping the cities of tomorrow. Together, let us embark on a journey to understand and unlock the immense possibilities that smart cities hold, as we strive to create sustainable, inclusive, and vibrant urban spaces for generations to come. (Kyunghun Min, 2019)

B. Problematic:

Cities meet unprecedented challenges in addressing the developing needs of citizens as cities develop larger and the pressing need for sustainable development. As a result, lots of cities around the world have adopted smart cities in order to improve quality of life, improve economic competitiveness, and encourage environmental sustainability. These initiatives make use of technology and data-driven solutions to optimize urban processes and improve citizens' living.

With growing popularity, smart city strategies range in productivity between cities, and there is no consensus on the best methods for applying them. This knowledge gap suggests the need for a comprehensive study to investigate the different approaches to smart city strategies around the world and analyze their results and benefits. As a result, the main objective of this thesis is to study and assess the smart city projects used in different cities throughout the world. By analyzing a range of case studies, including the Masdar SC Strategy, Sejong SC Strategy, Amsterdam SC Strategy, and Singapore SC Strategy, we will investigate the different approaches taken and evaluate their achievements, challenges, and lessons learned. This analysis will contribute to our understanding of the factors that contribute to successful smart city strategies by using the method SWOT, we will explore the strengths and weaknesses of the initiative, as well as the opportunities and threats that may impact its successful development framework and we're going to Propose strategy implementation in the new city of Hassi Messaoud. To achieve this, we will seek to answer two critical questions: What are the different approaches to smart city strategies worldwide, and how effective have they been? And second, what are the key factors that should be considered when developing a framework for implementing smart city strategies in Hassi Messaoud?

C. Hypothesis:

Three fundamental hypotheses have been developed from this perspective:

➢ Analyzing global approaches to smart city development can provide valuable insights and best practices for knowing the strategy to build smart cities and implementing the strategy in Hassi Messaoud.
➢ Implementing smart city strategies in Hassi Messaoud can serve as a model for other cities in the region seeking to improve urban development and residents' quality of life.
➢ Implementing smart city initiatives in Hassi Messaoud will improve urban services, infrastructure, and general quality of life for people.

D. Objectives:

The thesis aims to explore the different dimensions of smart cities, by these dimensions, the research seeks to gain a comprehensive understanding of the components and principles that contribute to sustainable urban development within the context of smart cities. also, this research is to explore the strategy of smart cities worldwide. By examining successful smart city initiatives such as the Masdar Smart City Strategy, Sejong Smart City Strategy, Amsterdam Smart City Strategy, and Singapore smart city Strategy, valuable insights can be gained regarding their potential application in the context of Hassi Messaoud.

The primary objective is to utilize the SWOT analysis method to assess the strengths, weaknesses, opportunities, and threats associated with each smart city strategy. This analysis will help in identifying the most suitable approach for Developing a smart city strategy and developing a customized strategy for the new town of Hassi Messaoud City based on the insights gained from this study.

The findings of this study will provide valuable insights for policymakers, urban planners, and other stakeholders involved in the planning and development of Hassi Messaoud, as well as other cities facing similar challenges. this thesis strives to demonstrate that smart city strategies have the potential to significantly enhance the sustainability and livability of cities, while simultaneously addressing pressing environmental and social concerns. By understanding the dimensions of smart cities and the strategies employed in other urban centers, a roadmap for sustainable urban development can be developed for Hassi Messaoud, leading to a more prosperous and inclusive future for its residents and stakeholders.

E. Thesis structure:

To develop this research, the following approach was chosen:

- **Part I: Theoretical part**

In Part 1, the thesis will delve into the concept of sustainable cities and sustainable Urban Development. and also, it will explain the evolution of cities From Sustainable to Smart

Part 2 of the thesis will focus on the dimensions of smart cities and the key components that contribute to their success. It will analyze the different aspects that encompass a smart city.

- **Part II: Practical part**

Moving forward, Part 3 will examine the strategies employed by prominent smart cities across the globe. Specifically, it will delve into the smart city strategies of Masdar City, Sejong Smart City, Amsterdam Smart City, and Singapore Smart City. These case studies will provide valuable insights into the approaches, challenges, and successes of implementing smart city initiatives in diverse urban contexts. The application of SWOT analysis method will be employed to evaluate the strengths, weaknesses, opportunities, and threats of the current strategies, enabling a comprehensive understanding of the strategy of cities.

Additionally, this section will explore the new city of Hassi Messaoud, situated in Algeria Wilaya of Ouargla. It will examine the existing development plans and strategies of Hassi Messaoud and assess their alignment with smart city principles. The application of the SWOT analysis method will be employed to evaluate the strengths, weaknesses, opportunities, and threats of the current strategies, enabling a comprehensive understanding of the city's potential for smart city transformation.

By studying the strategies of established smart cities and analyzing the unique context of the new city of Hassi Messaoud, this thesis seeks to provide valuable insights and recommendations for the city's transformation into a smart and sustainable urban environment. Through this research, it is anticipated that lessons learned from successful smart city initiatives can be applied to the development of Hassi Messaoud, contributing to the overall body of knowledge on sustainable urban development and fostering a blueprint for future smart cities.

F. The research methodology:

In order to find answers to the problem and the questions raised, to confirm or invalidate the predefined hypotheses, and to concretize our work objectives, we have opted for the following methodology Firstly, in the Theoretical Part, we will explore the concept of sustainable cities and trace the evolution from sustainable to smart cities. We will analyze the dimensions and key components of smart cities.

Next, in the Practical Part, we will examine the strategies employed by prominent smart cities globally. We will conduct a comparative analysis of these strategies and propose a comprehensive strategy for building smart cities that can be applied worldwide. Additionally, we will assess the existing plans of Hassi Messaoud and evaluate their alignment with smart city principles. Finally, we will apply the proposed strategy to transform Hassi Messaoud into a smart city.

Chapter 1: The Path to Sustainable Urban Futures

Introduction

In light of the increasing importance of sustainability, a new concept for urban development has emerged in recent years. This is the notion of sustainable cities that emphasize the effective integration and utilization of resources to achieve sustainable development. Sustainable cities are built on several key principles such as harmonization of relations and improving quality of life, preservation and phased restoration of the natural environment, creating opportunities for ecological balance while integrating modern technology into urban infrastructure. Such goals align closely with one of the United Nations' 2030 Agenda for Sustainable Development's targets- building inclusive, safe, resilient, and sustainable cities- defining this issue as a global priority. Thus, smart cities through their deployment of information and communication technologies can be applied towards sustainability in order to promote resource efficiency.

In this part examines what are Sustainable development and sustainable cities and the evolution of cities: From Sustainable to Smart cities

1. Sustainable development
1.1. What is sustainability?

Sustainability means meeting our own needs without compromising the ability of future generations to meet their own needs. In addition to natural resources, we also need social and economic resources. Sustainability is not just environmentalism. Embedded in most definitions of sustainability they also find concerns for social equity and economic development (What is sustainability?)

1.2. The definition of sustainability from the Office of Sustainability at the University of Alberta:

Sustainability is the process of living within the limits of available physical, natural, and social resources in ways that allow the living systems in which humans are embedded to thrive in perpetuity (What is sustainability?)

1.3. What is development? (Who are the developing countries in the WTO?, 2022)

Development is the process of growth, or changing from one condition to another. In economics, development is a change from a traditional economy to one based on technology.

1.4. What is sustainable development?

There are many ways to define sustainable development, Sustainable development was defined in the World Commission on Environment and Development's 1987 Brundtland report ´Our Common Future` as: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (Sustainable Development, n.d.)

The EU developed a strategy for sustainable development in 2001. A revised edition of this report, which was published in 2006, provides "a long-term vision for sustainability in which economic growth, social cohesion, and environmental protection go hand in hand and are mutually supportive." (Sustainable development, n.d.)

2. Sustainable Cities
2.1. What does it mean to be a sustainable city?

A sustainable city is one designed to address social, environmental and economic impact through urban planning and city management. Many sustainable initiatives are achieved by building eco-friendly alternatives into city infrastructure, such as adopting walk and bike lanes. (Meyer, 2023) Enforcing regulations and imposing fines can be an effective means of driving change toward sustainability. For instance, waste removal orders have been successful in reducing landfill waste. However, it's equally important to focus on reducing costs and fostering a thriving community for citizens alongside environmental efforts. This can be achieved through strategies such as planned infrastructure development, the creation of public green spaces, smart waste management systems, and other initiatives, all of which can contribute to leaving behind a net zero footprint for a more sustainable world.

2.2. Definition of a sustainable city

A sustainable city reduces environmental impacts through its activities and promotes sustainable consumption and production patterns in accordance with its own territorial, geographical, social, economic, and cultural conditions. It is a city that is resilient to the impacts of climate change reducing the vulnerabilities of its population. The perfect sustainable city would be one that is self-sufficient in energy, manages waste to produce energy, has more sustainable transport, maintains green spaces, and manages and uses its natural resources correctly. It would be a city that is built on the principles of ecology, education, and equality. Below we will analyze the characteristics of sustainable cities and how you can do your part to achieve a clean and ecological city. (Manueco, 2022)

2.3. The Traits of a Sustainable City and Eco-Friendly Urban Planning (Lee, 2021)

- **City-wide access to public transportation:** A sustainable city promotes the use of public transportation by making it accessible and convenient for residents. This can include investing in public transit infrastructure, such as buses, trains, and subways, and making it affordable for all residents.

Figure 1 train https://www.klook.com/activity/39045-rotterdam-ret-public-transport-day-pass/

- **Pedestrian- and bike-friendly sidewalks:** Sustainable cities prioritize walkability and bike ability by creating sidewalks and bike lanes that are safe and convenient for residents to use. This encourages people to walk or bike rather than drive, which helps to reduce traffic congestion and greenhouse gas emissions.

Figure 2 https://pin.it/6tRd2vC .2023   *Figure 3 https://pin.it/1w9TMcN .2023*

- **Electric car charging stations:** A sustainable city promotes the use of electric cars by installing charging stations throughout the city. This helps to reduce the use of fossil fuels and improve air quality.

Figure 4 charging stations https://cleantechnica.com/2020/02/17/largest-ev-fast-charging-station-in-the-us-opens-in-pasadena-california/ .2023

- **Renewable energy:** Sustainable cities prioritize the use of renewable energy sources such as solar, wind, and geothermal power to reduce reliance on fossil fuels.

Figure 5 RenewEnergy Park https://www.pinterest.com/pin/264516178106010249/ .2023

- **Sustainable architecture:** A sustainable city promotes sustainable architecture, which includes designing buildings that are energy-efficient, use environmentally-friendly materials, and promote the health and wellbeing of residents.
- **Urban agriculture and food production:** Sustainable cities promote urban agriculture and food production, which includes community gardens, rooftop farms, and other urban farming initiatives that help to reduce food waste, promote local food systems, and improve food security.
- **Strong social planning efforts:** A sustainable city prioritizes social planning efforts, such as affordable housing, healthcare, education, and community engagement, to ensure that all residents have access to basic services and amenities.
- **Green water management:** Sustainable cities prioritize green water management techniques, such as rain gardens and green roofs, to manage stormwater runoff and reduce the risk of flooding.

- **Green waste solutions:** Sustainable cities prioritize waste reduction and recycling programs to minimize waste and reduce the amount of trash that goes to landfills. This includes composting programs and other initiatives that encourage residents to reduce, reuse, and recycle.

3. The Evolution of Cities: From Sustainable to Smart

The transition from a sustainable city to a smart city has been driven by a combination of technological advancements, urban development pressures, and a desire to address social and environmental challenges in more efficient and effective ways. While sustainable cities focus on environmentally sound and socially inclusive urban development, smart cities add a layer of digital technologies to enhance urban governance, services, and infrastructure. The integration of digital technologies in urban

systems can provide new opportunities to enhance sustainability and livability, such as improving energy efficiency, reducing carbon emissions, and enhancing citizen participation. However, the implementation of smart city technologies must be carefully managed to avoid exacerbating social and environmental inequalities and empowering corporate interests.

The idea of smart cities has been evolving for several decades, and there is no single person or group who can be credited with starting it. The concept emerged in the 1990s with the emergence of information and communication technologies and the internet, which enabled the development of new digital tools and data-driven approaches to urban planning and management. In the early 2000s, a number of cities began to experiment with these technologies, using them to improve infrastructure, reduce energy consumption, and increase public safety.

One of the earliest examples of a smart city is often cited as Singapore, which launched its Intelligent Island program in 1992 with the goal of using technology to improve the quality of life for its residents. Other cities around the world, including Barcelona, Amsterdam, and Songdo, South Korea, have also gained recognition for their smart city initiatives in recent years.

the idea of smart cities has been driven by a combination of technological advancements, urban development pressures, and a desire to address social and environmental challenges in more efficient and effective ways. (Antoine Clarinval *, 2023)

4. Exploring the Reciprocal Relationship between sustainable cities and smart cities:

Sustainable cities and smart cities share a common goal of creating livable and efficient urban environments. While sustainable cities focus on reducing environmental impact and promoting social equity, smart cities use technology and data to optimize urban systems and services. However, there is a growing recognition of the reciprocal relationship between the two concepts, as smart technologies can support sustainability goals, and sustainable approaches can enhance the effectiveness of smart systems.

Smart technologies can support sustainability by enabling more efficient use of resources and reducing waste. For example, sensors and real-time data can optimize energy use in buildings, and smart transportation systems can reduce congestion and emissions. Smart technologies can also improve public services, such as waste management and emergency response, leading to a better quality of life for residents.

On the other hand, sustainable approaches can enhance the effectiveness of smart systems. For instance, green infrastructure, such as parks and urban forests, can mitigate the urban heat island effect and provide other ecosystem services, while also improving air quality and reducing the energy demand for cooling. Additionally, sustainable urban design can promote walkability and reduce the need for car-based transport, making smart transportation solutions more effective.

Therefore, there is a growing trend toward integrating sustainability and smart technologies in urban planning and development. This approach, often called "smart sustainable cities," aims to leverage the benefits of both concepts to create more livable, resilient, and equitable cities for all. (Mare", 2021)

Conclusion

In conclusion, sustainable development and sustainable cities are critical to addressing the environmental, social, and economic challenges facing cities today. The evolution of cities from sustainable to smart represents a new phase in this approach, where digital technologies and data-driven decision-making are incorporated to enhance sustainability and livability.

In this thesis part, we have examined the benefits of sustainable city planning, including improved public health, reduced greenhouse gas emissions, and increased social equity. We have also explored planning actions toward sustainable cities, such as promoting green infrastructure, implementing sustainable transportation systems, and supporting community engagement. However, we have also recognized the challenges of a sustainable city, such as funding constraints, limited public awareness, and the need for stakeholder collaboration.

Moreover, the evolution of cities from sustainable to smart provides exciting opportunities for enhancing urban sustainability and livability. By incorporating digital technologies, such as the Internet of Things, big data analytics, and artificial intelligence, we can create cities that are more efficient, responsive, and better equipped to address the complex challenges of the 21st century.

Overall, sustainable development and sustainable cities must continue to evolve and adapt to meet the changing needs of urban environments. By adopting a comprehensive and holistic approach to sustainable city planning, we can create cities that are more livable, sustainable, and equitable for all. With concerted efforts and collaboration between the government

Chapter 2: Comprehensive Study of the Smart City

Introduction

Smart cities are a relatively new concept that has gained traction in recent years due to the increasing use of technology in various aspects of our lives. In simple terms, a smart city is a city that uses technology and data-driven approaches to improve the quality of life for its citizens, increase sustainability, and enhance economic development. (Angeliki Maria Tol, 2020)

To achieve these goals, smart cities typically focus on six dimensions (Ilja Nastjuk, Simon Trang & Elpiniki I. Papageorgiou, 2022): smart people, smart government, smart environment, smart transportation, smart economy, and smart life. Smart people refer to the human capital of a city, which includes education, skills, and health. A smart government refers to the use of technology and data to improve governance, service delivery, and public participation. Smart environment refers to the use of technology to protect the environment and promote sustainability.

Smart transportation is all about using technology to enhance the efficiency, safety, and sustainability of transportation systems. The smart economy refers to the use of technology to drive innovation, entrepreneurship, and economic growth. Finally, smart life focuses on using technology to improve the quality of life for citizens in areas such as healthcare, safety, and entertainment.

To implement these dimensions effectively, smart cities typically rely on several key components (Ahmad, 2022), such as Internet of Things (IoT) devices, smart transportation, smart energy, smart buildings, smart waste management, smart water management, public safety and security, citizen engagement, open data, and smart governance. These components enable the collection, analysis, and dissemination of data to improve the overall functioning of the city and enhance the quality of life for its citizens.

In this part, we will delve deeper into the dimensions and components of smart cities, exploring their importance and potential benefits. By the end of this part, we hope to provide a comprehensive understanding of smart cities and their potential to shape the future of urban life.

1. What is the smart city

The term "smart city" is a concept, but academics and practitioners have yet to agree on a precise and consistent meaning. One of FG-SSC and UNECE's official definitions of the smart city is as follows: "A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, the efficiency of urban operation and services, and competitiveness while ensuring that it meets the needs of present and future generations regarding economic, social, environmental, as well as cultural aspects," according to the World Economic Forum. (Group 20 to develop standards to build smart and sustainable cities worldwide., 2016). The "Internet of Things," "Big data," and "Machine learning" are the three most popular technologies. (Digital Communications and Networks, 2018). Moreover, several words are used to characterize it, including "cyberville," "digital city," "electronic city," "flex city," "information city," "telicity," and "wired city."" (Sadiku & Justin Foreman, 2019). A smart city includes additional factors that influence sustainability and urban development, such as human capital, education, social capital, and environmental concerns, in addition to the use of technology (Andrea Caragliu, Chiara Del Bo, and Peter Nijkamp, 2011), By working with many stakeholders to produce better and sustainable Smart City initiatives that lower the costs of service supply and enable better management of a city's resources, a government is in charge of the administration and management of a Smart City. (Smart Cities Cybersecurity and Privacy, 2019)

- **Definition of Smart City from South Korea Law:** "smart city means a sustainable city wherein various city services are provided based on city infrastructure constructed by converging and integrating construction technologies, information and communications technologies, etc. to enhance its competitiveness and livability " (ACT ON THE PROMOTION OF SMART CITY DEVELOPMENT AND INDUSTRY, 2018)
- **Definition of Smart City from European Union: A** smart city is a place where traditional networks and services are made more efficient with the use of digital and telecommunication technologies for the benefit of its inhabitants and business (European Commission , n.d.)
- **Definition of Smart City from IDB (Inter-American Development Bank): A** Smart City is one that places people at the center of development, incorporates Information and Communication Technologies into urban management, and uses these elements as tools to stimulate the design of an effective government that includes collaborative planning and citizen participation (IDB(Inter-American Development Bank, 2016)

The technologies that smart cities use: (WHAT IS A SMART CITY? – DEFINITION AND EXAMPLES, n.d.)

- Internet of Things (IoT)
- Application Programming Interfaces (APIs)
- Artificial Intelligence (AI)
- Cloud Computing Services
- Dashboards
- Machine Learning
- Machine-to-Machine Communications
- Mesh Networks

2. Dimensions of smart cities:

Although there is no specific concept of smart cities, scientists have agreed on some dimensions that must be available in the city: smart people, the smart government, the smart environment, smart transportation, the smart economy, and smart life. (Sikora-Fernandez, 2016)

2.1. The smart people:

Smart people are residents of the "smart city" and have a high level of education and intelligence that allow them to create "smart technologies" and actively use them. Nonstandard and creative thinking, high intellect, and a desire to work in innovative sectors of the economy are also an indisputable attribute of "smart people" living in a "smart city" (Alina Yashina,Olga Vorobeva,Ekaterina Manzhula, 2019)

a. Benefit of smart people in SC

- **Increased innovation and creativity:** Smart people bring with them a wealth of knowledge, skills, and ideas, which can drive innovation and creativity in a smart city, leading to new technologies, businesses, and solutions to urban challenges.
- **Improved education and workforce development:** Smart people can also improve education and workforce development in a smart city, by promoting lifelong learning, skills development, and access to training and education programs.
- **Enhanced community engagement:** Smart people can also enhance community engagement, by promoting civic participation, volunteering, and social networks, which can strengthen social cohesion and resilience.
- **Increased entrepreneurship and business development:** Smart people can also drive entrepreneurship and business development, by creating new startups and supporting small businesses, which can contribute to economic growth and job creation.
- **Improved quality of life:** Smart people can also improve the quality of life in a smart city, by promoting cultural diversity, social inclusion, and access to services and resources that meet the needs of all residents. (WHAT IS A SMART CITY? – DEFINITION AND EXAMPLES, n.d.) (Carlos Moreno, 2021) (SMART CITY INDICATORS, n.d.)

2.2. The smart government:

Concerns the transformation of the local government into a transparent, efficient, and open administration to its citizens with the use of the information and communications technologies (ICT) , as well as the formulation of the appropriate SC policies. Governments and city governments play a major role in the SC growth by encouraging, funding, and authorizing urban innovation development and by generating policies for SC. (Leonidas Anthopoulos , Kleanthis Sirakoulis, Christopher G. Reddick, 2021)

a) The benefit of the smart government in SC

- **Improved efficiency and transparency:** By utilizing smart technologies such as data analytics and digital platforms, smart government initiatives can improve the efficiency and transparency of government operations, making it easier for citizens to access information and interact with their government.

- **Enhanced citizen participation:** Smart government initiatives can also promote citizen participation, by providing digital platforms for feedback and engagement, and utilizing data analytics to inform policy and decision-making.
- **Increased public safety:** Smart government initiatives can also improve public safety, by utilizing smart technologies such as video surveillance, facial recognition, and predictive analytics to prevent and respond to crime and emergencies.
- **Better resource allocation:** Smart government initiatives can also optimize resource allocation, by utilizing data analytics to identify areas of need and allocate resources more effectively.
- **Improved economic development:** Smart government initiatives can also promote economic development, by creating a more business-friendly environment, promoting entrepreneurship and innovation, and attracting new investment and talent to the city.

2.3. The smart environment:

Smart environment refers to the natural conditions of living in the city (e.g., green areas), pollution and resource management (e.g., reuse and replacement of resources) and environmental protection. Solutions proving a smart environment encompass, for example effective waste management, use of renewable energy sources and green urban planning. Information and communication technologies are used to improve the city's ecological systems. (Wojciech Kozłowski , Kacper Suwar, 2021)

a) **Benefit of a smart environment in a smart city**
- **Improved air and water quality:** By utilizing smart sensors and data analytics, smart environment initiatives can monitor and improve air and water quality, reducing pollution and promoting a healthier environment.
- **Enhanced waste management:** Smart environment technologies can also improve waste management, by optimizing waste collection routes, reducing waste generation, and promoting
- recycling and composting.

Figure 8 https://pin.it/6DTkmhb

Figure 9 https://pin.it/2CTBzMS

- **Increased energy efficiency:** Smart environment initiatives can also promote energy efficiency, by utilizing renewable energy sources, optimizing energy use in buildings and
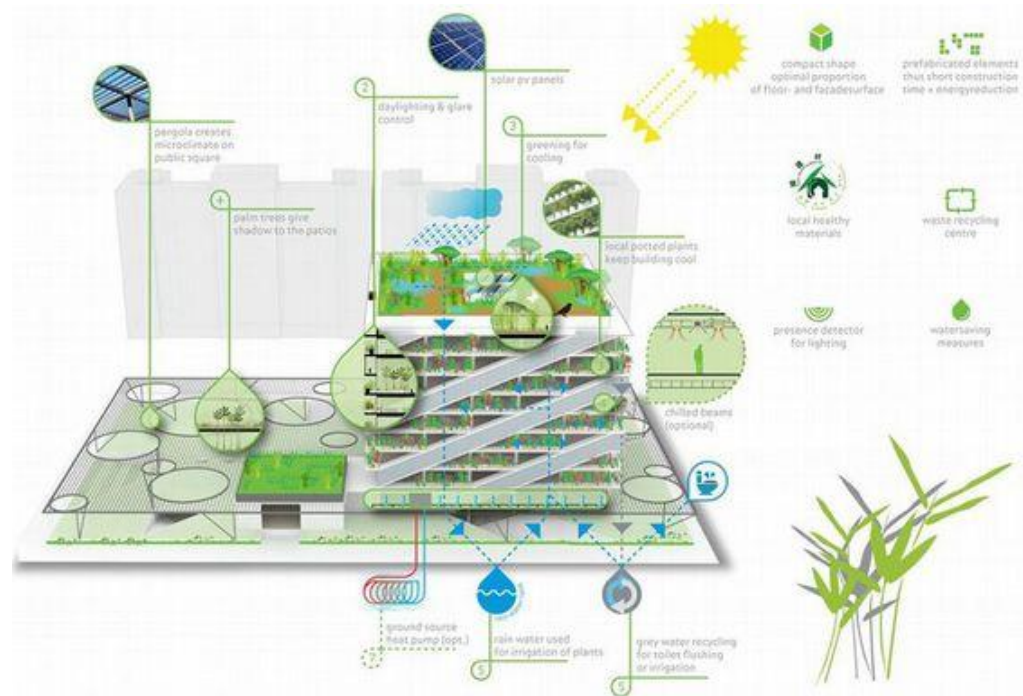
infrastructure, and promoting energy-efficient transportation options.

Figure 10 Energy-Efficient Buildings https://pin.it/6oAsMmy

- **Improved green spaces:** Smart environment initiatives can also enhance green spaces, by promoting the creation of new parks and green spaces, improving access to existing ones, and utilizing smart technologies to optimize maintenance and irrigation.
- **Better disaster preparedness and response:** Smart environment initiatives can also improve disaster preparedness and response, by providing real-time data on environmental conditions and enabling faster and more effective responses to natural disasters.

2.4. The smart transportation (Mobility):

Smart transportation enables solutions to improve urban mobility, reduce congestion on public transport, control pollution, and improve citizens' quality of life, especially in urban areas with high vehicle traffic density. (Roberto O. Andrade a, 2021)
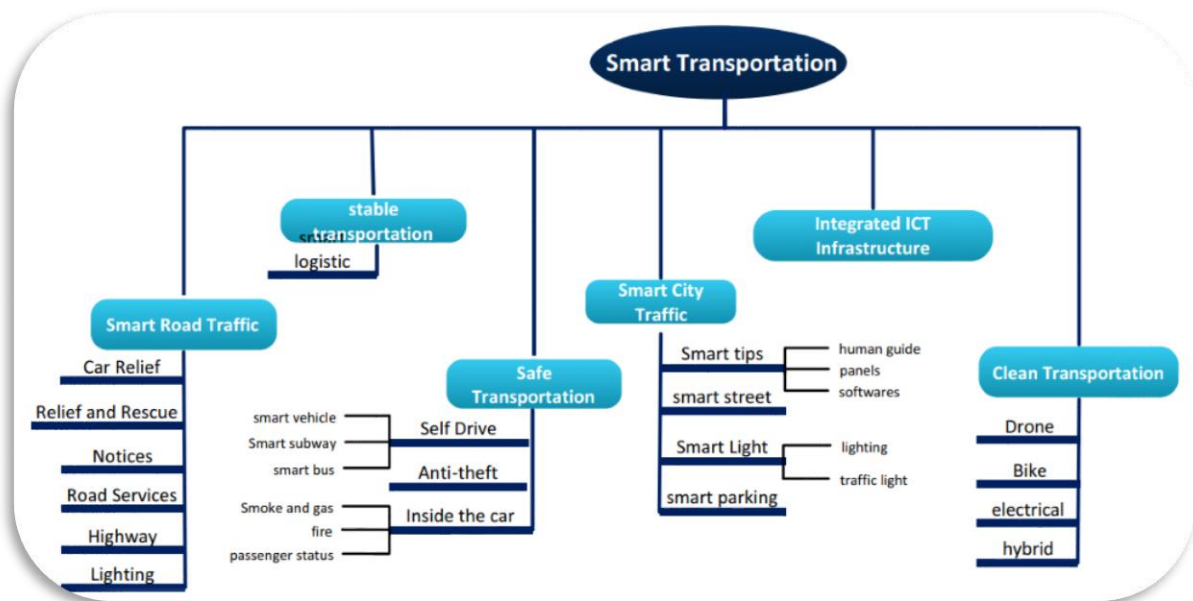
Figure 11 Proposed sub model of smart transportation (Houbakht Attaran . Nahid Kheibari . Davoud Bahrepour, 2022)

a) **Benefits of smart transportation (Mobility) in SC**
   - **Improved traffic flow:** Smart transportation technologies, such as intelligent traffic management systems, can help to optimize traffic flow, reducing congestion and improving travel times.
   - **Enhanced safety:** Smart transportation technologies can also improve safety on the roads, with features such as automated emergency braking, collision avoidance systems, and connected vehicle technology.

Figure 12 intelligent Transportation System (ITS) https://fr.digi.com/blog/post/smart-city-traffic-management-solutions .2023

   - **Reduced environmental impact:** Smart transportation can also reduce the environmental impact of transportation, by promoting the use of electric vehicles, optimizing traffic flow to reduce emissions, and encouraging sustainable transportation modes such as walking, biking, and public transit

Figure 13 Electric véricles https://pin.it/3ISyD5 . 2023

Figure 14 electric bike https://ebikegeneration.com/blogs/news/7-best-city-ebikes-that-are-worth-the-bucks.2023

Figure 15 https://pin.it/1MonLMO .2023

Figure 16 https://pin.it/4dItNOq.2023

- **Improved accessibility:** Smart transportation can also improve accessibility, particularly for individuals with disabilities, by providing real-time information on transit options, optimizing transit routes, and ensuring that transportation infrastructure is accessible to all.

Figure 17 https://pin.it/1uKTkf4.2023

Figure 18 https://pin.it/2KynNXp . 2023

- **Enhanced public transportation:** Smart transportation can also improve public transportation systems, by optimizing schedules, providing real-time information to passengers, and improving the overall experience for riders.

Figure 19 https://pin.it/2cuZTpM . 2023   Figure 20 https://oemkiosks.com/?page=smart-bus-shelters . 2023

Figure 21 https://pin.it/MbCB1Qk .2023   Figure 22 https://pin.it/3pt0rvV . 2023

2.5. The smart economy:

Smart economy refers to the competitiveness of the city focusing on innovation, entrepreneurship, trademarks, productivity and flexibility of the labor market, and integration into the domestic market. Information and communication technologies (ICT) are used to develop e-business and ecommerce and to enhance opportunities related to the production and service delivery and innovations as well as new products, services, or business models. (Wojciech Kozłowski , Kacper Suwar, 2021)

b) **Benefits of Smart economic in a smart City**
   - **Increased efficiency and productivity:** By utilizing smart technologies such as data analytics, artificial intelligence, and the Internet of Things (IoT), smart economic initiatives can optimize resource allocation, reduce waste, and increase productive
   - **Improved sustainability:** Smart economic initiatives can also promote sustainability by encouraging the use of renewable energy sources, reducing carbon emissions, and promoting environmentally friendly practices.
   - **Enhanced quality of life:** By improving access to resources, creating new job opportunities, and supporting small businesses, smart economic initiatives can enhance the overall quality of life for residents of a smart city.
   - **Increased economic growth:** Smart economic initiatives can also boost economic growth by attracting new businesses and investment, promoting innovation and entrepreneurship, and improving the competitiveness of existing businesses.

- **Improved public services:** Smart economic initiatives can also improve public services, such as transportation and healthcare, by utilizing data analytics and other smart technologies to optimize service delivery.

Figure 23smart health systeam https://pin.it/4zxmyPo . 2023
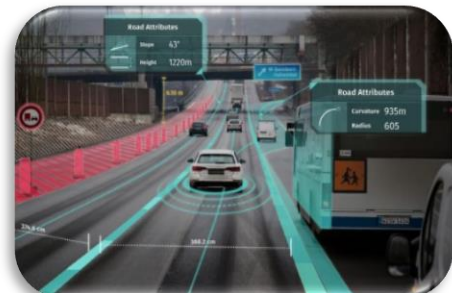
Figure 24traffic management https://pin.it/55YOjY3. 2023

2.6. The smart life (Living):

Smart Living It highlights one of the fundamental objectives of the sustainable and intelligent territory, namely the improvement of the quality of life of its citizens. Health, safety in the city, social cohesion and tourist attractiveness are also fundamental pillars of the Smart Living axis. (LIEGE, Smart city institute, 2021)

a) Importance of smart life (living) in a smart city

- **Quality of life:** Smart living can improve the quality of life for residents by providing access to health care, education, and cultural amenities. It can also improve safety and security through the use of smart technologies.

- **Convenience:** Smart living can make daily life more convenient through the use of technologies that automate tasks and simplify processes. This includes everything from smart home systems that control lighting and temperature to online portals that provide access to government services and information.

Figure 25 https://pin.it/7h4OAOx.2023

Figure 26 https://pin.it/7nLnDEO .2023

- Social connectivity: Smart living can promote social connectivity by providing opportunities for residents to connect with each other and participate in community events and activities. This can help build a sense of community and social cohesion.
- Well-being: Smart living can promote well-being by encouraging healthy lifestyles and providing access to health care and wellness programs. This includes everything from bike share programs and walking paths to telemedicine and mental health services.

Figure 27 https://pin.it/6bzpIYh 2023

Figure 28 https://pin.it/6f4peMu .2023

- Sustainability: Smart living can promote sustainability by encouraging eco-friendly practices and reducing waste. This includes everything from recycling programs and energy-efficient buildings to community gardens and composting programs.

Figure 29 recycling Bin https://pin.it/1jsZiCd .2023

Figure 30 Community gardent https://pin.it/4A9d0uG .2023

b) Benefits of smart life (living) in SC

- Efficient resource management: Smart cities utilize technology to efficiently manage resources like water, energy, and transportation, leading to reduced waste and costs.
- Improved public safety: Smart cities incorporate technologies such as sensors, cameras, and machine learning algorithms to improve public safety through faster emergency response times and crime prevention measures.
- Enhanced sustainability: Smart cities prioritize sustainable practices, including the use of renewable energy sources, green building designs, and eco-friendly transportation

options, which can help to reduce carbon emissions and promote environmental conservation.

- **Increased accessibility:** Smart cities use technology to make services and facilities more accessible for everyone, including people with disabilities and the elderly.
- **Better citizen engagement**: Smart cities involve citizens in decision-making processes and enable them to provide feedback through digital platforms, leading to more transparency and accountability. (SMART CITY INDICATORS, n.d.)

3. Smart City Components:

Smart cities are designed to use technology to improve the quality of life for citizens and enhance the sustainability and efficiency of urban infrastructure. Here are some key components of a smart city:

3.1. Internet of Things (IoT) Devices:

The Internet of Things (IoT) refers to the network of physical objects, such as devices, vehicles, and buildings, embedded with sensors, software, and connectivity, which enable them to collect and exchange data. These connected devices can communicate with other devices and systems, allowing them to function and share data seamlessly. (Simmons, 2023)

Sensors equipped with artificial intelligence, for example, can collect climate data in real-time and use this information to manage thermostats in public buildings. Autonomous electronic systems that can modify output signals according to environmental input variations and help reduce emissions leading to considerable savings in both energy and economic terms. (IoT for Smart Cities: how will the cities of the future work?, 2023)

a) IoT Technologies for Smart Cities: (Simmons, 2023)

In order to develop a genuinely smart city that can enhance the quality of life, the ultimate goal is to have IoT technologies integrated, with data flowing between devices without any interruption. More specifically, these IoT technologies include

- radio-frequency identification (RFID)
- near-field communication (NFC)
- low-power wide-area (LPWA)
- wireless telecommunications
- wireless sensor network (WSN)
- DASH7
- Addressing.

b) The IoT technologies that are being applied in smart cities: (IoT for Smart Cities: how will the cities of the future work?, 2023) (Simmons, 2023)

- Smart Lighting
- Smart Parking
- Waste Management
- Smart Grids
- Smart Buildings
- Maintenance

- Air Quality Monitoring
- Smart Transportation

- public safety
- Smart Meters
- Noise Monitoring

3.2. Smart Transportation:

Smart transportation systems use IoT technology to improve traffic flow and reduce congestion. Examples of smart transportation include autonomous vehicles, traffic management systems, and public transportation optimization (Zhou, Yang, Zhong, Chen, & Zhang, 2021)

a) **How Does Smart Transportation Work:** Here are some ways that smart transportation works in a smart city:

- **Intelligent Traffic Management:** Smart transportation systems use real-time traffic data to optimize traffic flow, reduce congestion, and improve safety. This is achieved through the use of intelligent traffic management systems, such as traffic sensors, connected traffic lights, and smart traffic signs.

Figure 31 Smart transportation systems https://pin.it/3tCEnGB

- **Integrated Public Transportation:** In a smart city, public transportation is integrated and connected to other transportation modes, such as bike-sharing, ride-sharing, and car-sharing. This allows commuters to easily switch between modes of transportation, reducing the number of cars on the road and improving overall traffic flow.

Figure 32 https://pin.it/3n5b1LP

Figure 33 https://pin.it/5h4SuEq

- **Autonomous Vehicles:** Smart transportation systems leverage autonomous vehicles to increase efficiency and reduce the environmental impact of transportation. Autonomous vehicles are equipped with advanced sensors and machine-learning algorithms that allow them to navigate roads and traffic safely and efficiently.

Figure 34 •Autonomou Vehicle https://pin.it/2AebqDf

Figure 35 Autonome Véhicule https://pin.it/nq6zYbD

- **Smart Parking:** Smart transportation systems also incorporate smart parking solutions, such as sensors that detect the availability of parking spots and guide drivers to available spaces. This helps reduce congestion and improves the overall parking experience.
- **Data Analytics:** Finally, smart transportation systems leverage data analytics to optimize transportation operations, improve safety, and reduce environmental impact. This involves the collection and analysis of data from various sources, such as traffic sensors, GPS devices, and social media, to gain insights into transportation patterns and behaviors.

Figure 36 smart transportation system
https://www.kyosan.co.jp/english/product/traffic04.html#:~:text=Traffic%20Sensors%20(ultrasonic%20type)&text=They%20are%20used%20for%20the,of%20a%20stable%20sensory%20function. 2023

smart transportation systems use advanced technologies to create more efficient, sustainable, and safe transportation systems in a smart city. (Smart Solar Benches, 2023)

b) Disadvantages of smart transportation: (Celona, 2020)
- **Budgeting:** Smart transportation systems require significant investment in infrastructure and technology, which can be expensive for governments and private entities.

- **Managing Data:** Smart transportation systems generate vast amounts of data that need to be collected, processed, and analyzed. This requires specialized skills and resources to manage effectively.
- **Mobility:** Smart transportation systems may not be accessible to all members of society, particularly those who are disadvantaged or living in remote areas.
- **Maintaining Privacy and Security:** Smart transportation systems collect and use personal data, which can raise privacy concerns. Additionally, there is a risk of cyber-attacks, which can compromise the system's security and put users at risk.

3.3. Smart Energy:

Smart energy systems use renewable energy sources, energy-efficient technology, and energy management systems to reduce energy consumption and promote sustainability. (J.Z. Thellufsen a, 2020)

a) **Five key opportunities for smart energy** (What is Smart Energy?, 2019)

- **Revenue Generation:** Smart energy solutions can provide new revenue streams for energy providers. By leveraging new technologies, such as smart grids, energy providers can sell excess energy to other providers or customers, enabling them to generate additional revenue.
- **Cost Savings:** Smart energy solutions can help companies save money by optimizing their energy usage. For example, by using sensors and data analytics, companies can identify areas where energy is being wasted and take steps to reduce consumption. This can result in significant cost savings over time.
- **Decarbonization:** Smart energy solutions can play a key role in decarbonizing the energy sector. By using renewable energy sources, such as wind and solar power, and implementing energy-efficient technologies, companies can reduce their carbon footprint and contribute to a cleaner, greener future.
- **Increased Capacity**: Smart energy solutions can help increase the capacity of the energy grid. By using smart grids and energy storage systems, companies can better manage peak demand periods, ensuring that there is enough energy available to meet the needs of customers.
- **Resilience:** Smart energy solutions can improve the resilience of the energy system. By implementing technologies such as microgrids and backup power systems, companies can ensure that they can continue to provide energy even in the event of a power outage or other disruption. This can help to improve the reliability of the energy system and reduce the impact of power outages on customers.

b) **Comprehensive Smart Energy Conservation Solutions for Home and Industry**

Smart energy conservation solution for home	Smart energy conservation solution for industry
– Provides granular data on energy consumption – Smart thermostats – LED light bulbs – Solar panels	– Energy management systems EMS – Industrial automation – Smart meter for industry – LED Lighting – HVAC Optimization

– Smart plugs	– Solar power
– Energy-efficient appliances	– Energy storage
– Insulation	– Combined heat and power CHP
– Window treatments	– Process optimization
– Smart power strips	– Renewable energy sources
– Geothermal systems	– Employee awareness and training

Source: (AI and IoT based Smart Energy Conservation Solution, 2023)

3.4. Smart Buildings:

Smart buildings use advanced sensors and automation technology to improve energy efficiency, optimize space utilization, and enhance the indoor environment. Examples of smart building technologies include building automation systems, smart lighting, and intelligent HVAC systems. (J. Aguilar, 2021)

a) Eight major benefits of smart buildings: (Clifton, n.d.)

Smart buildings have become increasingly popular in recent years due to their many benefits, which include:

- **Automation opportunities:** Smart buildings use automation to control various aspects of the building, such as lighting, heating, ventilation, and air conditioning. This automation helps to improve energy efficiency, reduce waste, and optimize operations.
- **Quantifiable building insights:** Smart buildings are equipped with sensors and monitoring systems that provide real-time data on building performance, occupancy, and environmental conditions.
- **Predictive maintenance:** Smart buildings use predictive maintenance techniques to identify potential problems before they occur.
- **Better resource utilization:** Smart buildings can optimize the use of resources such as water, energy, and materials.
- **Reduced energy consumption:** Smart buildings use advanced technologies to optimize energy consumption and reduce energy waste.
- **Real-time building insights:** Smart buildings provide real-time insights into building performance, occupancy, and environmental conditions.
- **Reduced operational costs:** Smart buildings can help to reduce operational costs by optimizing energy consumption, reducing waste, and improving efficiency.
- **New workplace opportunities:** Smart buildings can create new opportunities for collaboration and innovation by providing a flexible and dynamic workspace that supports the changing needs of modern businesses.

3.5. Smart Waste Management:

Smart waste management is an innovative approach to handling and collecting waste. Based on IoT (Internet of Things) technology, smart waste management provides data on waste generation patterns and behavior. This empowers municipalities, cities, and waste collectors to optimize their waste operations, become more sustainable, and make more intelligent business decisions. (nordsense.com, n.d.)
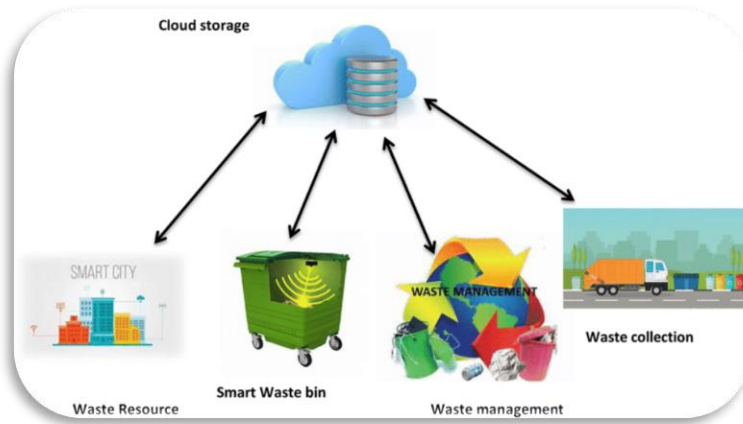
Figure 37 Smart Waste Management system https://www.researchgate.net/figure/Urban-smart-waste-management-system_fig4_341449321 2023

a) **How Does Smart Waste Management Work:** (The Ultimate Guide to Smart Waste Management, 2023)

Smart waste management systems work by using various technologies to optimize waste collection and disposal processes. These systems typically consist of four key components:

1. smart bin sensors
2. waste management platform

3. intelligent routing
4. container tracking**.**
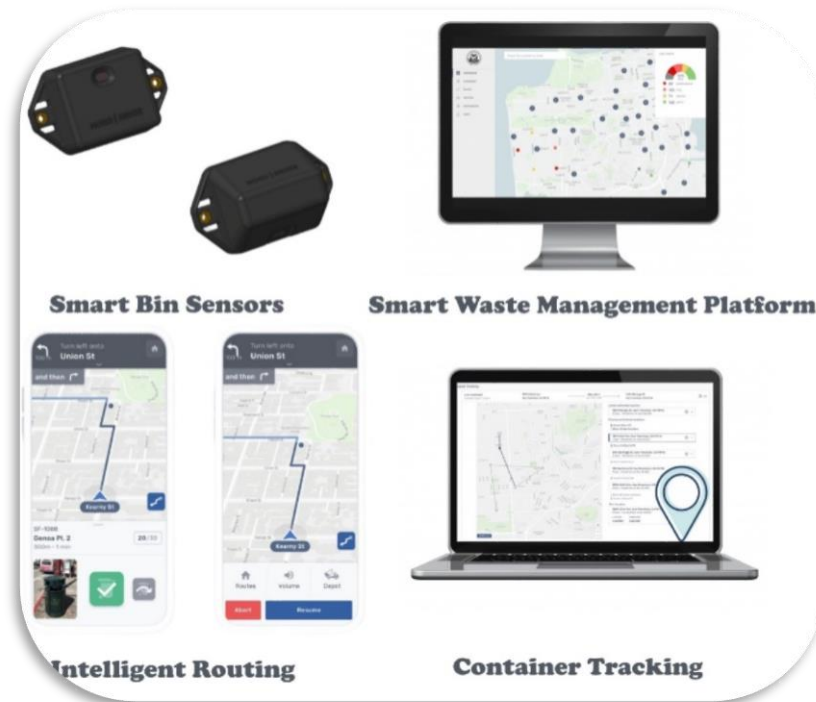
Figure 38 key components of the Smart Waste Management systems (The Ultimate Guide to Smart Waste Management, 2023)

b) **The Benefits of Smart Waste Management** (The Ultimate Guide to Smart Waste Management, 2023)

- **Optimized resources:** Smart waste management systems use real-time data analytics to optimize waste collection routes, resulting in cost savings and more efficient resource allocation.
- **Reduced costs:** By diverting waste to recycling and composting facilities, smart systems reduce landfill expenses and minimize the need for manual labor.
- **Cleaner streets:** Prompt and efficient waste collection by smart systems helps maintain clean streets, improving public health and safety while reducing litter and vermin risks.
- **Better working environments:** Smart waste management reduces manual labor, creating safer and more comfortable working conditions for employees.
- **Lower carbon emissions:** Optimized routes and reduced trips by smart systems decrease carbon emissions from waste collection. Increased recycling also reduces greenhouse gas emissions from landfills.
- **Increased recycling rates:** Real-time data on waste generation and collection enables targeted recycling education and infrastructure improvements, leading to higher recycling rates and reduced environmental impacts.

3.6. Smart Water Management:

Smart Water Management is the activity of planning, developing, distributing, and managing the use of water resources using an array of IoT technologies that are designed to increase transparency and make more reasonable and sustainable usage of these water resources. (Smart Solar Bench – a modern solution for urban spaces, 2022) High-technology solutions for the water sector include digital meters and sensors, supervisory control and data acquisition (SCADA) systems, and geographic information systems (GIS). (Kim, 2019)

a) **5 benefits of Smart Water Management Systems:** (Bernard, 2022)
- **Reducing waste of water-intensive industries:** Smart water management systems can help industries optimize their water usage, reducing the waste of water-intensive processes and saving water resources.
- **Monitoring water quality to fight pollution and diseases:** Smart water management systems can continuously monitor water quality, detecting any pollutants or contaminants and enabling swift responses to protect public health.
- **Improving the efficiency of water systems:** Smart water management systems can help utilities optimize their water distribution networks, reducing water loss and improving the overall efficiency of the system.
- **Creating awareness of household water use thanks to smart meters:** Smart meters can provide households with real-time information on their water usage, helping them to identify opportunities to save water and reduce their water bills.
- **Providing running water through innovative solutions all around the world:** Smart water management systems can be used to provide running water to underserved areas and regions facing water scarcity through innovative solutions such as water harvesting, recycling, and desalination.

b) **7 Benefits of IoT-powered Smart Water Management System in the Water Sector** (7 Benefits of IoT-powered Smart Water Management System in the Water Sector, 2023)

- **Real-time analysis of water consumption:** IoT sensors can collect and analyze data on water consumption in real time, enabling water utilities to better understand usage patterns and identify areas for conservation.
- **Reduced maintenance costs:** IoT sensors can detect potential problems in the water distribution system before they become major issues, reducing maintenance costs and minimizing the risk of service disruptions.
- **Better communication among stakeholders:** IoT devices can improve communication between water utilities and their customers, enabling more efficient response times to service requests and complaints.
- **Predicting potential failures:** By analyzing data from sensors, IoT-powered smart water management systems can predict potential failures in the water distribution system, allowing water utilities to proactively address them.
- **Remote monitoring:** IoT devices can provide remote monitoring of water distribution infrastructure, enabling water utilities to identify and address issues without sending personnel into the field.
- **End-to-end services:** IoT-powered smart water management systems can provide end-to-end services, from monitoring and analyzing water usage to billing and customer service.
- **Interactive reports**: IoT-powered smart water management systems can generate interactive reports that provide insights into water usage patterns, enabling water utilities to make data-driven decisions about infrastructure investments and conservation initiatives.

3.7. Public Safety and Security:

Smart public safety is the adoption of those sensors and sensor data to create field intelligence and situational awareness, while at the same time providing historical trends that can be used for proactive and predictive policing as technologies continue to innovate. (Polly, 2022)

a) **Securing Smart Cities:** Connected smart city devices should be protected by comprehensive IoT security solutions (device to cloud). (Smart Cities: Threat and Countermeasures, n.d.)

- **Firmware Integrity and Secure Boot:** Firmware is the software that runs on hardware devices, including IoT devices. Firmware integrity ensures that the firmware is not tampered with or modified, which can result in security vulnerabilities. Secure boot ensures that only authorized firmware can run on a device, preventing unauthorized access and hacking attempts. Secure boot involves validating the firmware's digital signature before allowing it to run on the device**.**
- **Mutual Authentication:** Mutual authentication is the process of verifying the identity of both the device and the server it's communicating with. This is important in preventing man-in-the-middle attacks, where an attacker intercepts communications between the device and the server and steals sensitive information. Mutual authentication ensures that only authorized devices can communicate with the server and vice versa.
- **Security Monitoring and Analysis:** Security monitoring and analysis involve monitoring the smart city infrastructure for security threats and analyzing data to detect patterns and anomalies. This includes monitoring network traffic, identifying potential threats, and responding to security incidents promptly.

- **Security Lifecycle Management:** Security lifecycle management involves managing the entire lifecycle of a device or system, from design and development to decommissioning. This includes implementing security measures throughout the device's lifecycle, such as secure coding practices, regular software updates, and proper disposal of devices at the end of their lifecycle**.**

3.8. Citizen Engagement:

Citizen engagement is crucial in decision-making. It enables two-way communication between the public and local government, allowing residents to actively participate in decisions that impact the area. This platform gives citizens a voice to share their opinions and grievances and offers advice for better governance. The outcome leads to changes that benefit everyone involved. (Appleton, beesmart.city, 2020)

Figure   39   https://www2.gov.bc.ca/gov/content/governments/services-for-government/service-experience-digital-delivery/citizen-engagement . 2023

a) **Benefits of Citizen Engagement in smart city** (How smart cities can increase citizen engagement, 2022) (Appleton, HOW SMART CITIES ARE BOOSTING CITIZEN ENGAGEMENT, 2020)
- **Better decision-making:** Citizen engagement can provide valuable insights into the needs and expectations of the citizens, which can be used to make informed decisions about the city's development.
- **Improved services:** Citizen engagement can help identify areas where services can be improved, such as public transportation, waste management, and safety measures.
- **Increased transparency:** Citizen engagement can increase transparency in the decision-making process, allowing citizens to understand how and why decisions are being made.
- **Enhanced community involvement:** Citizen engagement can foster a sense of community involvement and ownership of the city's development, leading to increased civic pride and participation.
- **Improved quality of life:** Citizen engagement can help identify and address issues that affect the quality of life in the city, such as air pollution, traffic congestion, and access to public spaces.
- **Increased innovation:** Citizen engagement can provide a platform for innovative ideas and solutions to emerge, allowing the city to stay ahead of the curve in terms of technology and sustainability.
- **Greater accountability:** Citizen engagement can hold city officials accountable for their decisions, ensuring that they are working in the best interests of the citizens they serve.

3.9. Open Data:

Open data is just that – open. Anyone can access, share and use it free of charge to better connect and interact with their cities (Howells, 2018). open data is a major component of smart cities that is critical for facilitating multi-scale urban management and improving other qualities such as adaptability, efficiency, interoperability, flexibility, transparency, and real-time response capacity. In addition, they are seen as major enablers for transparency and trust, which is a pre-condition for developing participative and smart communities. (Martin Lněnička,Anastasija Nikiforova,Mariusz Luterek,Otmane Azeroual,Dandison Ukpabi,Visvaldis Valtenbergs,Renáta Máchová, 2022) . According to a report by the World Bank, open data can contribute significantly to the development of smart cities by enhancing transparency, improving decision-making processes, and fostering innovation and collaboration among different stakeholders. By making data openly available, smart cities can enable individuals and organizations to use it to develop new applications, services, and solutions that can benefit the city and its residents. (World Bank, n.d.)

b) **Benefits of open data in smart city** (SMITH, 2017)

- **Transparency:** Open data can increase transparency in government operations and decision-making processes by providing citizens with access to information that was previously unavailable.
- **Better decision-making:** Open data can help city officials make better decisions by providing them with real-time information on various aspects of the city, such as transportation, public safety, and infrastructure.
- **Improved services:** Open data can enable service providers to develop more efficient and effective services by allowing them to analyze data and identify patterns and trends.
- **Increased innovation:** Open data can serve as a foundation for innovation by providing entrepreneurs and developers with the raw materials they need to create new products and services.
- **Enhanced citizen engagement:** Open data can encourage citizen engagement by enabling citizens to participate in the city's decision-making processes and hold officials accountable for their actions.
- **Economic benefits:** Open data can stimulate economic growth by creating new job opportunities and attracting new businesses to the city.
- **Improved quality of life:** Open data can contribute to improving the quality of life in the city by providing citizens with better access to information and services.

c) **Challenges to the Provision and use of Open data** (SMITH, 2017)

- **Privacy concerns:** There is a risk that personal information may be disclosed through open data, which could compromise individual privacy.
- **Loss of control over confidential information:** Governments may be hesitant to release sensitive or confidential information through open data portals, as they may lose control over who can access it.
- **Expense of creating and curating an open data portal**: The process of creating and maintaining an open data portal can be expensive, particularly for smaller cities or organizations with limited resources.

- **Data must be machine-readable:** To be useful, open data must be in a machine-readable format, which can be a challenge for organizations that lack the technical expertise to convert data into this format.
- **Constant updating and promotion:** Open data must be constantly updated and promoted to remain relevant and useful to citizens and businesses, which can require a significant investment of time and resources.
- **Effort must be spent engaging the community:** In order to be successful, open data initiatives must involve active engagement with the community to ensure that the data being released is relevant to citizens and businesses.

3.10. Smart Governance:

define the smart government as "the ability of governments to make better decisions through the combination of ICT-based tools and collaborative governance" (Erna Ruijer,Anouk van Twist.Timber Haaker.Thierry Tartarin.Noel Schuurman.Mark Melenhorst.Albert Meijer, 2023)

Conclusion

Smart cities are at the forefront of urban development, embracing progressive techniques to shape the cities of the future. These cities prioritize efficiency, sustainability, and livability by incorporating innovative approaches across various dimensions. Smart governance ensures effective decision-making, while smart infrastructure fosters a harmonious relationship with the environment. Smart transportation systems offer seamless mobility options, while smart economic strategies drive growth and prosperity. Ultimately, the aim is to create a more connected and intelligent urban environment that enhances the well-being and quality of life for its residents. Through the integration of these smart dimensions, cities are paving the way for a more prosperous and sustainable future.

IoT devices, smart transportation, smart energy, smart buildings, smart waste management, smart water management, public safety and security, citizen engagement, open data, and smart governance are all key components in realizing the vision of a smart city. Each of these components has specific advantages such as higher efficiency, cost savings, lower emissions, improved safety, and improved citizen quality of life.

The significance of smart cities also cannot be emphasized. Cities must become more efficient and sustainably designed as population numbers rise. Numerous urban-area issues, such as traffic congestion, air pollution, and resource depletion, can be addressed through smart cities. Smart cities may maximize resource usage, eliminate waste, and improve the well-being of their residents by utilizing cutting-edge technologies and data analytics.

In conclusion, the development of smart cities is a crucial step toward producing metropolitan regions that are efficient, livable, and sustainable. Smart cities have the potential to change urban development by utilizing cutting-edge technologies and fresh ideas, offering considerable advantages for residents, companies, and governments alike.

Therefore, smart cities represent an essential step in ensuring that everyone has a more livable and successful future.

Chapter 3 : Analyzing Smart City Strategies

Introduction

Smart Cities are becoming a popular concept owing to the increasing need for sustainability in urban areas. Different countries around the world have launched their Smart City initiatives with varying levels of success. In this analysis, we will explore and compare examples from Amsterdam, Masdar, Singapore, and Sejong Smart Cities as they provide valuable insights into how effective smart city strategies can be developed. To develop a comprehensive strategy for the city's growth and development, we will employ the SWOT analysis method. SWOT stands for Strengths, Weaknesses, Opportunities, and Threats, and is a powerful tool for strategic planning by analyzing these cases' strengths and weaknesses, we aim to develop an overall strategy that could serve as a blueprint for future smart city projects worldwide.

1. Smart Cities Strategy
1.1. Sejong Smart City Strategy: Sejong

Smart City, located in South Korea, is a prime example of the latest urban planning and design developments, incorporating innovative technology and sustainability principles. Here is the Strategy of Sejong Smart City:
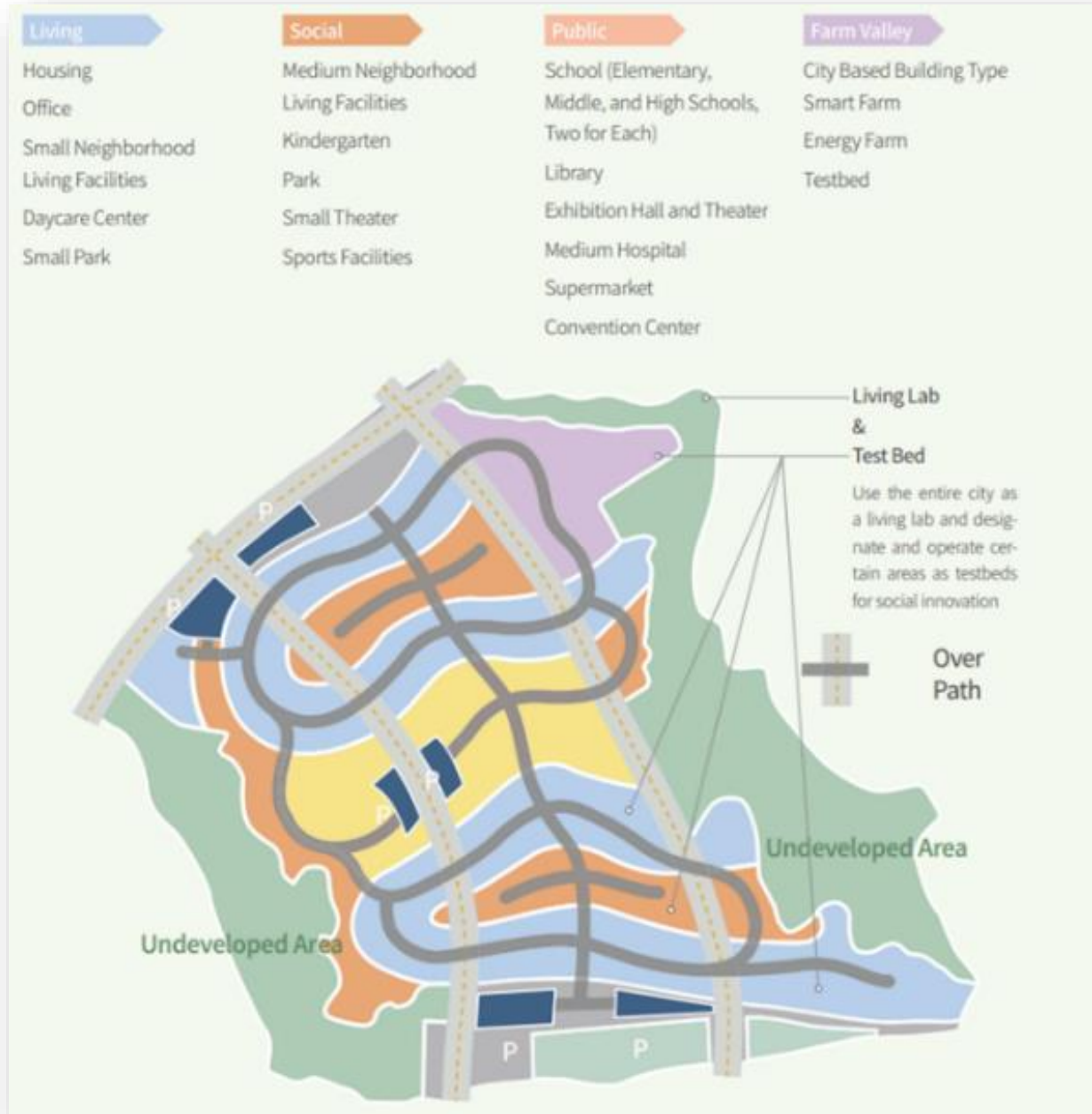
Figure 401 Sejong National Pilot Smart City Land Utilization Plan in the Basic Conception Plan (July 16, 2018

1) **Integrated Transport System:** Sejong Smart City has an integrated transport system that connects different modes of transportation, including buses, subways, and cars. This system is designed to reduce traffic congestion, save travel time, and enhance the overall transportation experience.
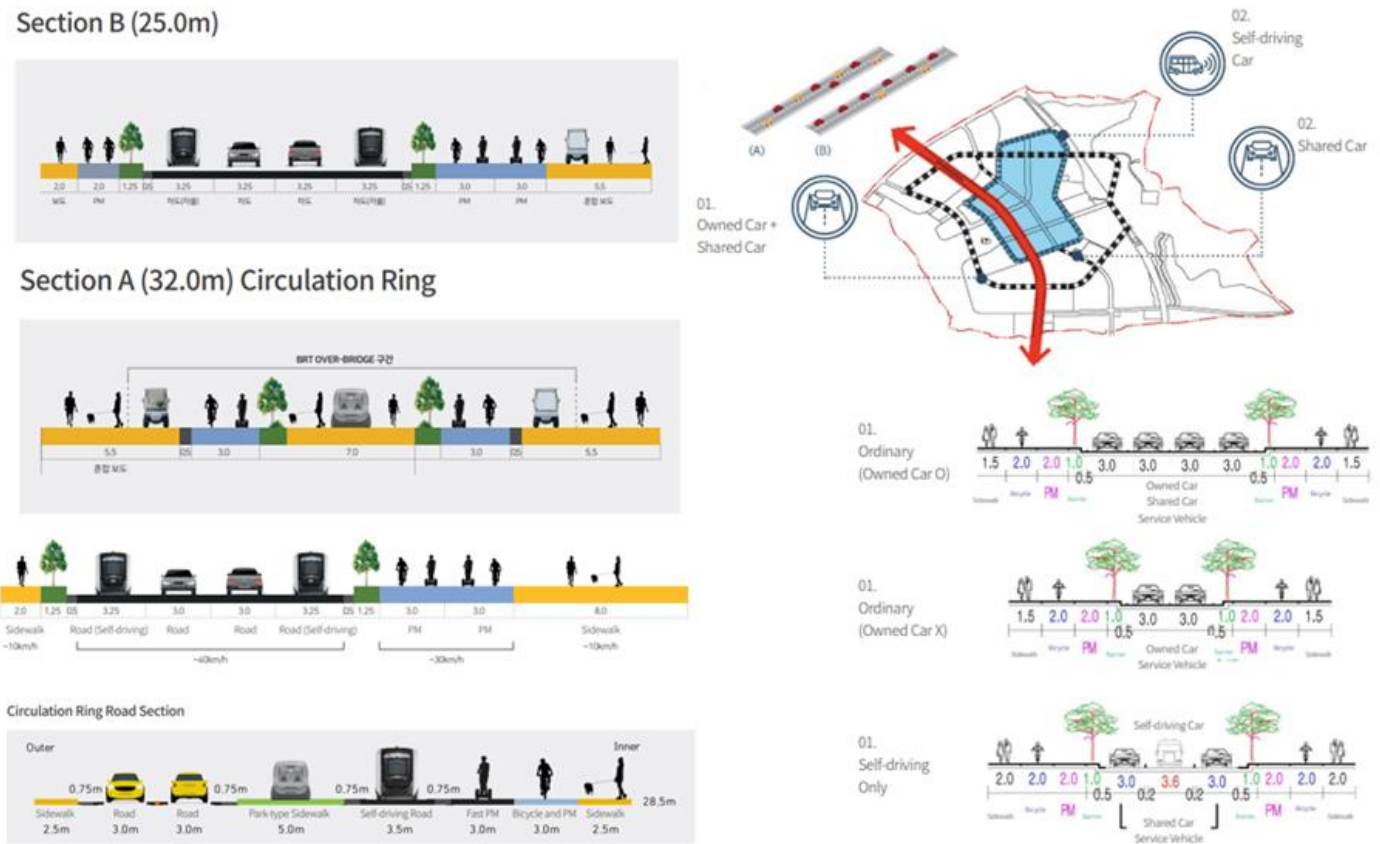
Figure 41 The design of roads in city (Jaeseung Jeong, 2018)

2) **Energy Efficiency:** The city focuses on eco-friendliness and self-sufficiency in energy through renewable sources, aiming to achieve a zero-energy status by optimizing renewable energy sources such as solar panels. They also aim to have all buildings rated 1++ in terms of energy efficiency and push for certification levels up to level 5 under their stringent zero-energy building program.

3) **Smart Buildings:** The buildings in Sejong Smart City are equipped with smart technologies that allow for remote control of lighting, heating, and cooling systems. The smart building technologies also provide real-time data on energy consumption, which can be used to optimize energy usage and reduce

costs.
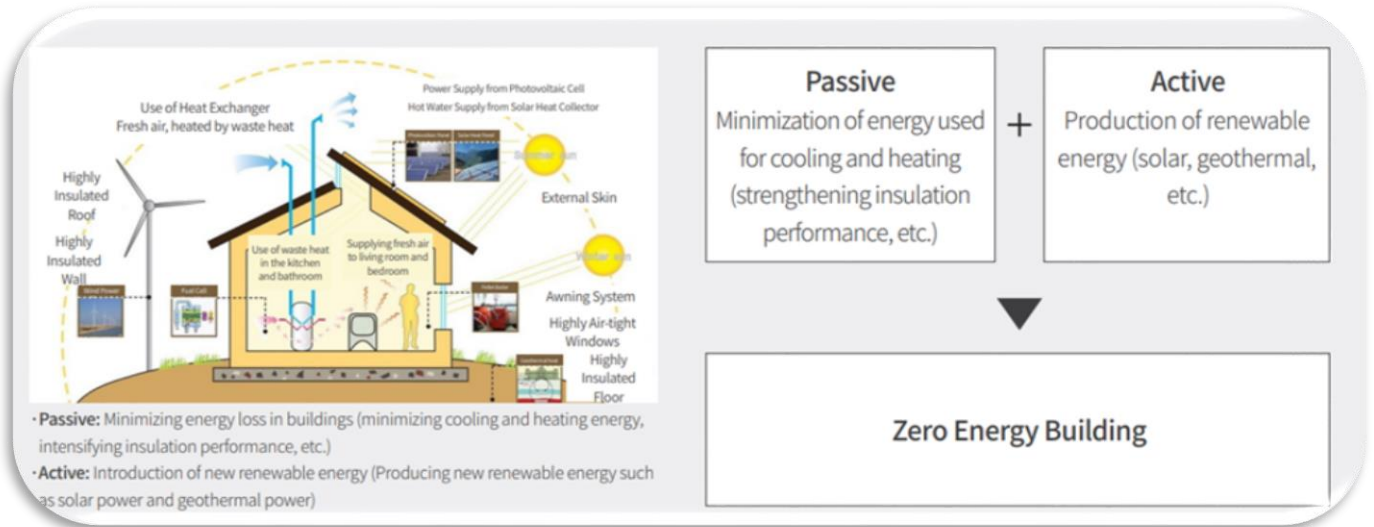
Figure 42 Conceptual Scheme of a Zero Energy Building (Jaeseung Jeong, 2018)

4) **Smart Healthcare:** Sejong Smart City has advanced healthcare facilities that use innovative technologies, such as telemedicine, health monitoring devices, and big data analytics. These technologies help to improve healthcare access and quality of care.
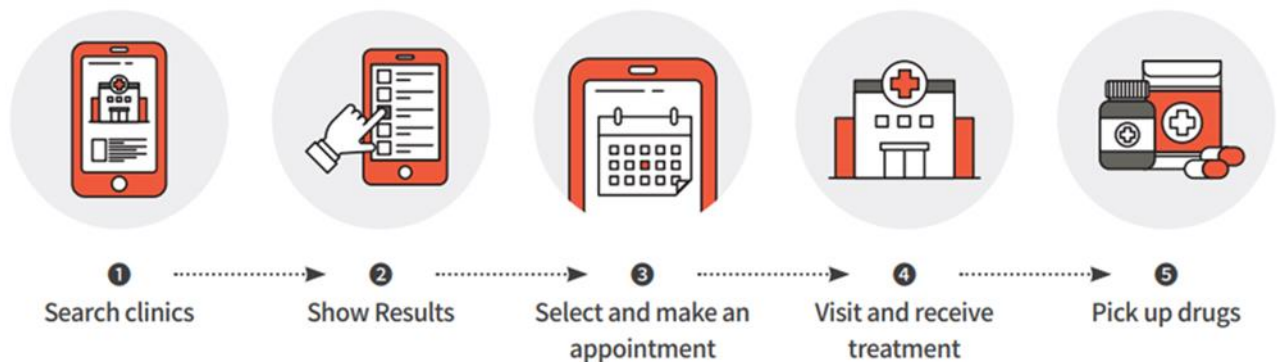
Figure 43 Personalized Medical Service and Emergency Response (Jaeseung Jeong, 2018)

What is an integrated network of clinics service? It is a service that integrates the Sejong National Pilot Smart City and medical institutions located in Sejong City into a single network. This enables residents to select, make appointments, and receive treatment at a medical institution anywhere at any time. At the same time, personal medical records can also be shared. Ultimately, we aim to build an integrated connection system of EMR – EHR – PHR

5) **Smart Education:** Sejong Smart City has an advanced education system that uses digital technologies to enhance learning. The education system is designed to provide personalized

learning experiences that cater to the individual needs of each student. Personalized Educational Environment Centering on Discussion and Description

6) **Public Safety:** Sejong Smart City has a comprehensive public safety system that uses advanced technologies, such as surveillance cameras, sensors, and big data analytics, to ensure public safety. The system also includes emergency response services that can quickly respond to any incidents.

Figure 44 Crime Prevention and Emergency Response Services (Jaeseung Jeong, 2018)

Crime Prevention and Emergency Response Services: The integrated network of clinics in the Sejong National Pilot Smart City utilizes various channels for crime prevention and emergency response. It gathers real-time data for integrated management and operation, including surveillance drones for monitoring parks and nature areas. The service prioritizes public safety and utilizes AI-based systems for video analysis, ensuring real-time response and providing follow-up guidelines. It caters to all residents and visitors, with a focus on early morning and late evening hours. The network plays a vital role in enhancing safety and well-being in the smart city.

7) **Culture and shopping:** Sejong Smart City developed flexible performing culture spaces for a variety of performances and cultural events. This service was designed to connect performers and potential audiences. and also integrated Shipment Service for Goods Bought at Individual Stores is offered.

8) **Smart Tourism:** Sejong Smart City has a smart tourism system that provides tourists with personalized recommendations based on their interests and preferences. The system uses big data analytics and machine learning algorithms to provide accurate recommendations, which help to enhance the overall tourism experience

Source : From the preparation of the student based on these references

1.2. Masdar Smart city Strategy:

Masdar City is a planned city project in Abu Dhabi, United Arab Emirates, with the objective of creating a low-carbon, sustainable urban development. The Abu Dhabi Future Energy Company (Masdar) developed the city in 2006 with the goal of developing a model for communities in the future that are both sustainable and economically viable.

Figure 45 *Masdar City Master Plan* *(Masdar, Masdar City Master Plan, 2018)*

The Masdar City strategy involves several key elements, including:

1. **Zero-carbon energy:** The city is designed to be powered entirely by renewable energy sources, such as solar and wind power. This includes the use of photovoltaic panels, concentrated solar power, and wind turbines.

> **The Masdar Wind Tower** is a type of wind tower designed for sustainable cooling in buildings. The tower uses the natural wind to create a cooling effect by drawing hot air from the building and exhausting it out the top of the tower. This creates a draft of cool air that is then drawn back into the building, creating a natural air conditioning system. The Masdar Wind Tower is an innovative solution for sustainable cooling in buildings and streets that harnesses the power of the natural environment.

Figure 46 Masdar Wind Tower (pinterest, n.d.)

2. **Green buildings:** All buildings in the city are designed to be highly energy-efficient, with features such as insulation, shading, and natural ventilation. The city also has a strict building code that requires all new buildings to be constructed to the highest environmental standards

   – **International Renewable Energy Agency (IRENA) HQ**: The IRENA HQ is a 32,064-square-metre complex and the UAE's first 4 Pearl building based on the Sustainable Pearl Building Rating System. Passive design and smart-energy management systems enable the complex to consume 64% less energy than typical office buildings in Abu Dhabi. (masdar.ae)

Figure 47 International Renewable Energy Agency (IRENA) HQ (masdar.ae, 2022)

−   The Eco-Villa consumes less than one quarter energy than traditional villas (ECO-VILLA, 2022)

ECO-VILLA FEATURES
SMART DESIGN AND RENEWABLE ENERGY
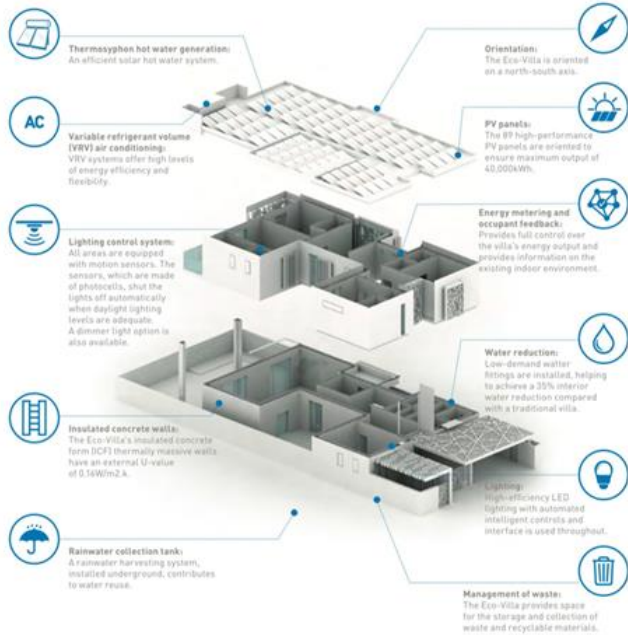
ECO-VILLA
GENERATES MORE ENERGY THAN IT CONSUMES

MASDAR CITY IS COMMITTED TO PROVIDING SUSTAINABLE HOUSING SOLUTIONS FOR ABU DHABI'S GROWING POPULATION.

The Masdar City Eco-Villa continues Abu Dhabi's tradition of innovation by pioneering a new concept for the design, construction and operation of sustainable family homes. Solar photovoltaic (PV) panels are installed to generate more electricity than the Eco-Villa consumes.

ECO-VILLA GFA: 405 sqm

25m x 36m

1. Living Room
2. Dining Room
3. Kitchen
4. Laundry Room
5. Maid's Room
6. Majlis
7. Guest Bathroom
8. Guest Bedroom
9. Courtyard
10. Master Bedroom
11. Family Room
12. Bedroom 1
13. Bedroom 2

Figure 48 MASDAR CITY ECO-VILLA (ECO-VILLA, 2022)

ECO-VILLA
ENVIRONMENTAL HIGHLIGHTS

DETAILS OF ENERGY PRODUCTION AND CONSUMPTION

Renewable Energy Output Eco-Villa		Energy Demand Eco-Villa		Produces more energy than it consumes
40,000 kWh per year	−	**39,285** kWh per year	>	**0** kWh per year

ENERGY CONSUMPTION

Traditional Villa	Eco-Villa
350 KWH sqm / year	**97 KWH** sqm / year

ECO-VILLA
ECONOMIC VALUE

	Traditional Villa	Eco-Villa
Based on energy consumption of:	350kWh sq.m/year	0kWh sq.m/year
Annual energy cost saving based on energy price of 31.8 fils/kWh		AED32,500

ECO-VILLA
SUMMARY

Energy consumption of **97kWh**, offset by the Eco-Villa's solar PV panels	**72%** energy reduction compared with a traditional villa of comparable size	**90%** of construction materials are locally sourced
0% Net-zero energy Eco-Villa uses 0kWh sq.m/year	**100%** Renewable Energy	Eco-friendly construction materials
	Eco-Villa mitigates **36 tonnes** of CO$_2$ annually	Reused and certified timber

Figure 49 MASDAR CITY ECO-VILLA NET-ZERO ENERGY (ECO-VILLA, 2022)

The Eco-Villa is an energy-efficient housing solution that consumes less than one-quarter of the energy compared to traditional villas.

3. **Sustainable transportation:** The city is designed to encourage walking, cycling, and the use of electric vehicles, with a comprehensive network of pedestrian walkways and cycle paths. There is also a public transport system, including a light rail network and electric buses (NAVIA Vehicle, Eco-Bus , the Personal Rapid Transit PRT).

Figure 50 Eco-Bus (INTRODUCING A NEW FUTURE FOR TRANSPORTATION, 2018)

Figure 51 NAVYA vehicle (masdar.ae, 2022)

Figure 52 PRT (network, n.d.)

Figure 53 Sustainable materials in use at Masdar City (masdar news, 2023)

Figure 54Street in Masdar city (Masdar City, 2023)

4. **Waste management:** The city has a comprehensive waste management system, with separate facilities for recycling, composting, and waste-to-energy conversion.
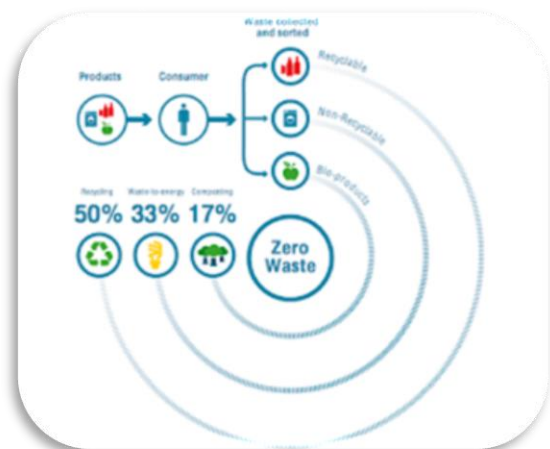
Figure 55 Zero Waste in Masdar City (city, 2022)

5. **Water conservation:** The city is designed to reduce water consumption through features such as low-flow fixtures, water-efficient landscaping, and the use of recycled water for irrigation.
6. **Innovation hub:** Masdar City is intended to be a center for innovation and research in sustainable energy and urban development. The city is home to a number of research institutes and technology companies, and hosts events such as the annual Abu Dhabi Sustainability Week.

Overall, Masdar City's strategy focuses on creating a sustainable and livable community in the desert region that serves as a model for future cities around the world.

Source :From the preparation of the student based on these references (masdar.ae, 2022) (Chopra, 2020) (Classifying Pathways for Smart City Development: Comparing Design, Governance and Implementation in Amsterdam, Barcelona, Dubai, and Abu Dhabi, 2020) (Linking Smart Cities Concept to Energy-Water-Food Nexus: The Case of Masdar City in Abu Dhabi, UAE, 2018)

1.3. Amsterdam Smart City strategy

Amsterdam is one of the world's top smart cities, and its goal is focused on using technology to improve the quality of life for its residents while also becoming more sustainable and productive. The essential components of Amsterdam's smart city approach are:

Figure 56 Plan Amsterdam Structural Vision 2040http://fansterdam.weebly.com/plan-amsterdam.html .2022

1. **Open data:** Amsterdam has embraced the use of open data as a way to drive innovation and create new solutions. The city has a dedicated portal where citizens and developers can access a wealth of data on topics such as transport, energy, and the environment. By making this data available to the public, Amsterdam is encouraging collaboration and innovation.
2. **Smart mobility:** Amsterdam is known for its cycling culture, and the city is using technology to make cycling even more attractive. The city has invested in a network of smart bike lanes

that use sensors to track usage and adjust traffic signals in real-time. Amsterdam is also testing autonomous vehicles, electric buses, and other innovative transport solutions.

Figure 57 https://www.archdaily.com/920413/the-20-most-bike-friendly-cities-in-the-world-according-to-copenhagenize-2019

Figure 58https://bikecity.amsterdam.nl/en/road-safety/

Figure 59https://www.reuters.com/technology/self-driving-roboats-ready-testing-amsterdams-canals-2021-10-27/

Figure 60https://marineterrein.nl/en/experimenten/meet-olli-the-self-driving-minibus/ .2022

3. **Energy efficiency:** Amsterdam has set an ambitious goal of becoming carbon-neutral by 2050, and technology is playing a key role in achieving this goal. The city is investing in smart grids, energy storage, and other solutions that can help reduce energy consumption and increase the

Figure 61https://www.amsterdam.nl/en/policy/sustainability/renewable-energy/#:~:text=From%202012%20to%20mid%2D2019,400%20MW%20of%20solar%20energy. 2023

use of renewable energy sources.

4. **Citizen engagement:** Amsterdam has recognized that the success of its smart city strategy depends on the participation and engagement of its citizens. The city has created a platform called Amsterdam Smart City https://amsterdamsmartcity.com, where citizens, businesses, and government agencies can share ideas and collaborate on projects.

source: From the preparation of the student based on these references (Amsterdam smart city, 2023) (Lopes, 2020) (Kuyper)

1.4. Singapore SC Strategy:

The Singapore Smart City strategy is a comprehensive plan that employs technology and innovation to improve inhabitants' lives, increase economic growth, and make the city more sustainable and livable. This strategy's major components include

Figure 62 *https://drive.google.com/file/d/17GmEEbNkpJp6VsDo_mecYz44aKuh7fHc/view* *2023*

1. **integrated and Connected Infrastructure:** Singapore's Smart Nation initiative aims to create a seamless and integrated infrastructure that connects various systems, such as transportation, healthcare, public safety, and utilities, to enable efficient and sustainable urban management.

2. **Building a Smart Transportation System:** The initiative aims to transform the city's transportation system by leveraging technology to make it more efficient and environmentally sustainable. This includes the implementation of autonomous vehicles, the development of a real-time traffic monitoring system, and the integration of public transportation with on-demand ride-sharing services.

Figure 63 *https://www.smartnation.gov.sg/initiatives/transport .2023*

3. **Data-driven Governance:** The Smart City strategy emphasizes the collection and analysis of data to inform decision-making and improve service delivery. This involves the deployment of sensors, IoT devices, and advanced analytics tools to gather and analyze data on various aspects

of city life. here are some public online portals(https://data.gov.sg/ , https://developers.data.gov.sg/ ,
https://apiservices.iras.gov.sg/iras/devportal/   ,
http://www.mytransport.sg/content/mytransport/home/dataMall.html , https://secure.mas.gov.sg/api/Search.aspx ,
http://www.onemap.sg/   ,   https://api.singpass.gov.sg/   ,   https://www.singstat.gov.sg/find-data   ,
http://www.tablebuilder.singstat.gov.sg/publicfacing/mainMenu.action , https://www.nparks.gov.sg/treessg ,
https://www.ura.gov.sg/maps/)

4. **Digital Services and Citizen Engagement:** The government of Singapore is committed to enhancing citizen engagement by providing digital services and tools that make it simpler for citizens to communicate with and obtain public services.
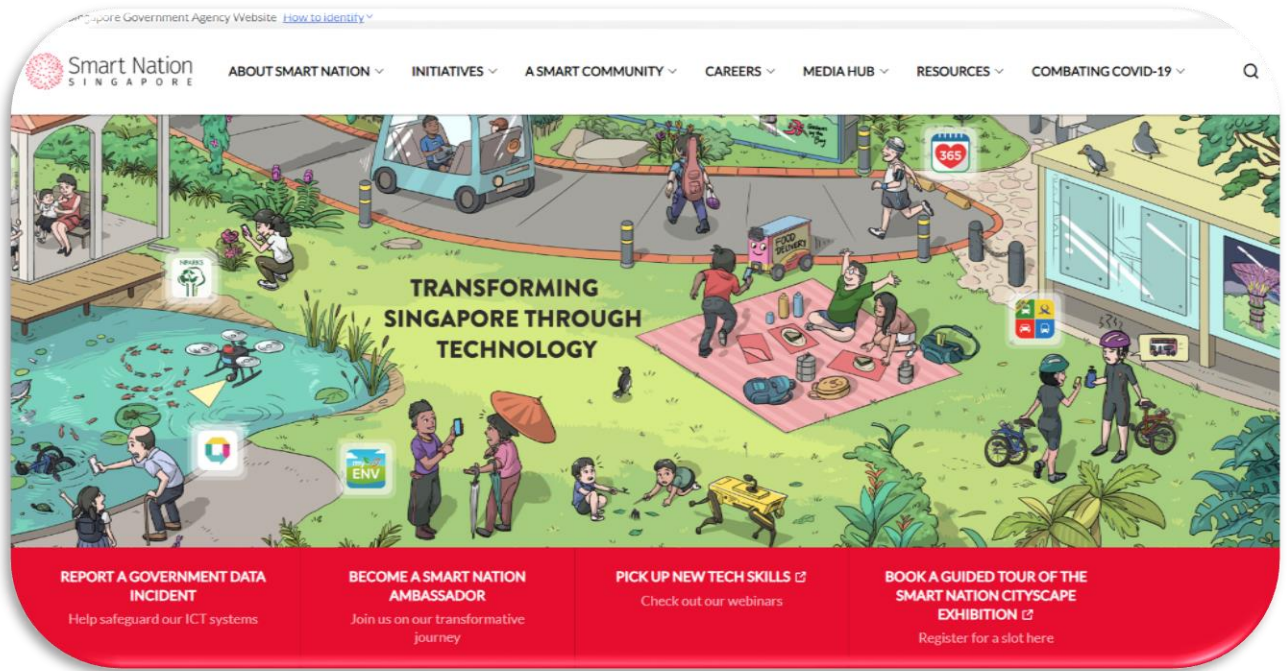
Figure 64 Singapore websitehttps://www.smartnation.gov.sg/ .2023

5. **Sustainable Environment:** The Smart City strategy also focuses on creating a sustainable environment by promoting green technologies, such as renewable energy, smart grids, and energy-efficient buildings, and reducing carbon emissions.

Figure 65https://www.mirygiramondo.com/5-interessanti-curiosita-su-singapore/ 2023

6. **Innovation and Collaboration:** To achieve its goals, Singapore has fostered a culture of innovation and collaboration among government agencies, private sector organizations, and

academic institutions. This involves partnering with industry leaders to develop cutting-edge technologies and solutions that address the city's most pressing challenges.

the Singapore Smart City strategy is a forward-looking approach to urban management that seeks to create a more livable, sustainable, and technologically advanced city for all its citizens.

 source: From the preparation of the student based on these references (Smart Nation Singapore, n.d.) (City of the Future: Singapore , 2018) (Smart cities: The Singapore case) (Joo, 2020)

2. Method SWOT

we can use the SWOT analysis in the Smart Cities Strategy to identify the strengths and weaknesses of the initiatives, as well as the opportunities and threats that may impact its successes. This information can then be used to develop a more robust and effective strategy for implementing smart city solutions Here's a Cities SWOT analysis:

2.1. Method SWOT in Sejong SC Strategy

Sejong Smart City is a modern, high-tech city that incorporates advanced technologies and innovative solutions to enhance the quality of life for its residents.

Table 1 Method SWOT in Sejong SC Strategy

Strengths	Sejong Smart City's strengths involve modern technological infrastructure, smart transportation systems, a sustainable environment, and an excellent quality of life for its citizens. The city's high-tech infrastructure provides efficient resource and service management, making it an attractive option for both companies and citizens
Weaknesses	Sejong Smart City's weaknesses include its small size, lack of cultural diversity, and dependence on government support. These factors have a chance to prevent the city's capacity to recruit a varied range of citizens and businesses, as well as its financial resources for growth and development.
Opportunities	Sejong Smart City has many opportunities for growth and development, including enhancing private sector investment, technical infrastructure growth, and the creation of new job opportunities. Also, the city's central Korean location allows easy access to major markets and transportation networks, which could attract more companies and residents to the area.
Threats	Competitive from other smart cities, economic insecurity, and disasters are all risks to Sejong Smart City's future growth and success. To address these challenges, the city must continue investing in infrastructure, diversifying its economy, and creating strong emergency planning strategies.

source: From the preparation of the student based on the references mentioned in the strategy,2023

2.2. Method SWOT in Masdar SC Strategy

The city is designed to be a model for sustainable urban development and relies on renewable energy sources, efficient resource management, and advanced technology to minimize its carbon footprint and enhance the quality of life for its residents.

Table 2 Method SWOT in Masdar SC Strategy

Strengths	▪ Masdar City has a clear vision and mission to become a model for sustainable

	urban development.
	▪ The city has a strong commitment to renewable energy sources and has set a target to generate 100% of its energy needs from renewable sources.
	▪ Masdar City has attracted international attention and investment, which can help promote its brand and attract talent and resources.
	▪ The city has a strong partnership with the Abu Dhabi government, which can provide support and resources to help achieve its goals.
	▪ Integrated approach: The city has an integrated approach to design, planning, and operation, which helps to create a cohesive and efficient environment.
	▪ Use of cutting-edge technology: Masdar Smart City uses advanced technologies, such as automated transportation systems and smart grids, to improve the efficiency and sustainability of the city.
Weaknesses	▪ Masdar City is still in the stages of development
	▪ The city's strict sustainability standards can increase the cost of construction and maintenance, which may limit its attractiveness to investors and residents.
	▪ Masdar City is located outside of Abu Dhabi city center, which can make it less accessible and convenient for some residents and visitors.
	▪ The city is still in the process of attracting businesses and job opportunities, which may limit its ability to retain residents and stimulate economic growth.
Opportunities	▪ Masdar City can continue to leverage its sustainability credentials to attract investors, businesses, and talent from around the world.
	▪ The city can collaborate with the Abu Dhabi government to promote sustainable urban development in the region and beyond.
	▪ Masdar City can explore partnerships with innovative technology companies to develop new solutions and services that can enhance its sustainability and quality of life.
	▪ The city can focus on developing a strong cultural and recreational scene to attract more residents and visitors.
	▪ Research and development Masdar Smart City are a hub for research and development in sustainable technologies, which could lead to new innovations and economic opportunities.
	▪ International recognition the city's focus on sustainability and advanced technology has gained international recognition, which could attract new investment and tourism.
Threats	▪ The global economic and political environment may affect Masdar City's ability to attract investment and resources.
	▪ Changes in the regulatory and policy environment may affect the city's ability to implement its sustainability standards and achieve its goals.
	▪ The city may face competition from other smart city projects and sustainable urban developments around the world.
	▪ The city's strict sustainability standards may limit its ability to adapt to changing market demands and consumer preferences.

source: From the preparation of the student based on the references mentioned in the strategy,2023

2.3. Method SWOT in Amsterdam SC Strategy

Table 3 Method SWOT in Amsterdam SC Strategy

Strengths	▪ **Amsterdam has a long history of innovation and sustainability, which**

	makes it a perfect location for the development of smart city solutions. ▪ **Amsterdam has a highly educated and competent workforce that can help to create and implement smart city projects.** ▪ The city has a modern infrastructure, including a robust transportation system, which can be used to utilize smart city solutions.
Weaknesses	▪ The Amsterdam Smart City Strategy might experience challenges involving residents and stakeholders, which might affect the project's success. ▪ The city's savings to invest in smart city projects may be limited. ▪ Existing stakeholders that are happy with the present status order and are nervous to adopt new technology can object.
Opportunities	▪ The city has the opportunity to encourage private sector investment and cooperation, which may provide technological and financial resources to support smart city projects. ▪ The Amsterdam Smart City Strategy can serve as an example for other cities around the world, encouraging sharing of information and collaboration. ▪ Smart city solutions can help cities manage environmental and social problems, such as reducing vehicle traffic and rising the quality of the air.
Threats	▪ Concerns about the security and privacy of data could impede smart city solution use, and the quick pace of technological change can make it hard to keep up with the latest advances while keeping the importance of smart city solutions. ▪ change in government priorities may have an impact on the long-term sustainability of the Amsterdam Smart City Strategy.

source: From the preparation of the student based on the references mentioned in the strategy,2023

A. Method SWOT in SINGAPORE SC Strategy

Table 4 Method SWOT in SINGAPORE SC Strategy

Strengths	• Singapore is known for its advanced infrastructure and technology adoption, making it a natural fit for a smart city initiative. • The government has a strong commitment to sustainability, with a goal of becoming a "zero-waste nation" by 2030. • Singapore has a highly educated workforce and a strong innovation ecosystem that can support the development of new technologies and solutions.
Weaknesses	• Despite its reputation for innovation, Singapore faces challenges in fostering a culture of innovation and creativity among its citizens. • The city-state is small, which limits the scope and scalability of some smart city initiatives. • There are concerns about privacy and security in the context of a smart city, and these issues will need to be addressed to ensure public trust.
Opportunities	• Singapore has a strong foundation for data analytics and machine learning, which can be leveraged to support a range of smart city initiatives. • The government has set ambitious goals around sustainability, which creates opportunities for innovation and investment in this area. • Singapore is a hub for international business and finance, which can provide a platform for global collaboration and investment in smart city projects.
Threats	• The rapid pace of technological change creates risks around obsolescence and

	the need for ongoing investment in new solutions.
	• There may be challenges around the integration of disparate systems and data sources in a smart city environment.
	• Cybersecurity threats pose a significant risk to the success of smart city initiatives and will require ongoing vigilance and investment

source: From the preparation of the student based on the references mentioned in the strategy,2023

2.4. SWOT Analysis of Masdar, Singapore, Amsterdam, and Sejong Smart Cities:

Based on the SWOT analysis of Masdar, Singapore, Amsterdam, and Sejong smart cities, we can draw some conclusions and make some recommendations for smart city strategies in general:

Table 5. SWOT Analysis of Masdar, Singapore, Amsterdam, and Sejong Smart Cities

Strengths	All four cities have unique strengths that set them apart from other smart cities, such as Masdar's focus on renewable energy, Singapore's strong government support, Amsterdam's emphasis on citizen participation, and Sejong's planned approach to sustainability. Advanced technologies are a common strength among all four cities, indicating that technology is a crucial component of smart city strategies.
Weaknesses:	The high cost of development and maintenance is a shared weakness among all four cities, indicating that funding is a critical issue for smart city projects. Limited scalability is a weakness for Masdar, Sejong, and Amsterdam, indicating that it is essential to consider how smart city solutions can be scaled to accommodate population growth and changing needs. Concerns about privacy and surveillance are a weakness for Singapore, indicating that ethical considerations must be an integral part of smart city planning.
Opportunities:	The potential for economic growth and new opportunities for businesses is a shared opportunity among all four cities, indicating that smart city strategies can have significant economic benefits. Improved sustainability and reduced carbon footprint are opportunities for Singapore, Masdar, and Amsterdam, indicating that smart city solutions can have a positive impact on the environment. Increased citizen engagement and collaboration leading to more effective smart solutions are opportunities for Amsterdam and Sejong, indicating that citizen participation is a critical aspect of successful smart city projects.
Threats:	The risk of an economic downturn impacting investment and growth is a shared threat among all four cities, indicating that smart city projects must be economically sustainable. Technological obsolescence is a threat for Masdar, Amsterdam, and Sejong, indicating that smart city solutions must be continually updated to remain effective. Political instability is a threat to Masdar and Sejong, indicating that smart city planning must consider geopolitical risks.

source: From the preparation of the student based on the references mentioned in the strategy,2023

Inference: the SWOT analysis suggests that smart city strategies should be designed with an integrated approach that considers technology, funding, scalability, ethics, environment, citizen

participation, and geopolitical risks. In addition, smart city projects should aim to achieve economic sustainability and remain adaptable to changing technological and social contexts.

3. Comparative analysis of the strategy of Masdar, Singapore, Amsterdam, and Sejong smart cities.

Masdar City, Sejong Smart City, Singapore, and Amsterdam City are all examples of cities that have implemented innovative strategies to address various urban challenges. While each city has its unique features and approach to urban development, we can compare and contrast their strategies based on several key aspects:

Table 6. Comparative analysis of the strategy of Masdar, Singapore, Amsterdam, and Sejong smart cities

Sustainability	Masdar City and Sejong Smart City are both designed to be eco-friendly and sustainable cities. Masdar City is a planned, zero-carbon city that aims to be entirely powered by renewable energy sources, while Sejong Smart City focuses on reducing energy consumption through the use of smart technology and advanced building management systems. Singapore has implemented several measures to reduce its carbon footprint, including a carbon tax, green building standards, and a comprehensive public transportation system. Amsterdam is known for its cycling culture and has invested heavily in cycling infrastructure and sustainable transportation options.
Technology	All four cities have embraced technology as a way to enhance the quality of life for their residents. Masdar City has implemented a smart grid that enables the efficient distribution of energy, as well as a driverless electric pod system for transportation. Sejong Smart City has developed an integrated platform that manages various aspects of city life, including transportation, energy, and public safety. Singapore has developed a comprehensive smart city platform, which collects data from sensors and other sources to inform decision-making. Amsterdam has implemented smart traffic systems and has developed a range of innovative technologies to improve the quality of life for its residents.
Urban Planning	Masdar City and Sejong Smart City are both designed to be sustainable, pedestrian-friendly cities that prioritize public spaces and green areas. Singapore has implemented strict urban planning policies to ensure a high quality of life for its residents, including strict zoning regulations and the preservation of green spaces. Amsterdam has prioritized cycling infrastructure and pedestrian-friendly streetscapes and has implemented a range of policies to promote sustainable urban development.
Innovation	All four cities have embraced innovation as a key driver of economic growth and development. Masdar City has a research and development center that focuses on renewable energy and sustainable technologies. Sejong Smart City is home to several high-tech companies and has implemented a range of innovative technologies. Singapore has developed a thriving startup ecosystem and invests heavily in research and development. Amsterdam is home to several innovative companies, particularly in the technology sector, and has implemented a range of policies to support entrepreneurship.

source: From the preparation of the student based on the references mentioned in the strategy2023

Inference: the examples of Masdar City, Sejong Smart City, Singapore, and Amsterdam emphasize the importance of sustainability, technology, urban planning, and innovation in creating cities that are eco-friendly Through their commitment to renewable energy, smart technology, pedestrian-friendly design, and innovative approaches, and make cities livable, and focus in forward-thinking. These cities demonstrate the potential for a harmonious balance between human needs, environmental preservation, and economic growth.

4. Proposed Smart City Strategy

A smart city strategy can include techniques that have been successful and lessons acquired from the examples of Masdar, Singapore, Amsterdam, and Sejong. Using these examples, the smart city strategy can include the following elements:

Table 7 Proposed Smart City Strategy

Propose 1
1. **Integrated planning approach:** A smart city strategy should involve a comprehensive and integrated planning approach that considers all aspects of urban life, such as transportation, housing, energy, environment, and citizen participation. The example of Masdar smart city demonstrates the benefits of an integrated approach to sustainable urban development.   2. **Investment in advanced technologies**: A smart city strategy should prioritize investment in advanced technologies that can improve the quality of life, sustainability, and efficiency of urban systems. The example of Singapore's smart city highlights the importance of government support and investment in smart initiatives.   3. **Focus on sustainability:** A smart city strategy should prioritize sustainability by incorporating renewable energy sources, green infrastructure, and sustainable transportation solutions. The example of Amsterdam's smart city demonstrates the benefits of a focus on sustainable transportation and energy solutions.   4. **Citizen participation:** A smart city strategy should prioritize citizen participation and engagement by involving residents in the planning and decision-making process. The example of Amsterdam's smart city demonstrates the benefits of citizen participation and collaboration leading to more effective smart solutions.   5. **Scalability:** A smart city strategy should consider how smart city solutions can be scaled to accommodate population growth and changing needs. The example of Sejong smart city highlights the importance of planning for scalability from the outset.   6. **Ethical considerations**: A smart city strategy should consider ethical considerations, such as privacy and surveillance, to ensure that smart city solutions are designed with citizen rights and values in mind. The example of Singapore's smart city demonstrates the importance of ethical considerations in smart city planning.

source: From the preparation of the student based on the references mentioned before 2023

Cities can create more comfortable, sustainable, and effective urban settings by integrating these elements into a smart city strategy

Conclusion

The global example analysis of the smart cities in Amsterdam, Masdar, Singapore, and Sejong provided a thorough picture of effective smart city programs. From examining these case studies, we found that each city has its unique approach to urban development, all four have embraced sustainability, technology, urban planning, and innovation as key drivers of their success. By prioritizing these areas, these cities have been able to address various urban challenges and create a high quality of life for their residents, it is clear that to fulfill sustainability goals, smart cities need to make large investments in their technological infrastructure. Success also heavily depends on the creation of proper data privacy and security rules. Policymakers should concentrate on using technology as an enabler to improve urban services and citizen involvement while achieving environmental sustainability goals to build an effective smart city plan. Finally, by working together across sectors, including government agencies, businesses, and residents, important stakeholders may develop better urban environments and communities that enrich lives now and into the future!

Chapter 4: Analyzing the Study Area

Introduction

Through this part, we are aiming to collect and consolidate all the necessary data and information about the new town of Hassi-Messaoud that will lend us better insight into the creation of the city and the strategy that apply. Our main objective is to delve deeper into its composition by carefully scrutinizing each detail at hand so that we can draw comprehensive conclusions from it. This process requires us to gather every minuscule piece of pertinent information through various sources before analyzing it holistically. Only then would we be able truly to uncover hidden patterns within the strategy of the town, finally allowing us to make informed decisions based on detailed analysis rather than just surface-level observations to decide if the city is smart?

1. Presentation of the Town of Hassi-Messaoud:
1.1. Technical datasheet

Table 8. Technical datasheet

Technical datasheet	
Situation	The new town of Hassi-Messaoud -Ouargla-Algeria
Area	4483 Hectares
Projected population	80,000 inhabitants
Density	17.84 inhabitants/ hectare
Client	Public authority in the Ministry of Energy and Mines
Prime contractor	DONGMYEONG Group
Accommodations	18,400
Public facilities	450
Number of jobs planned	40,000

Source: (ENVH, 2012)
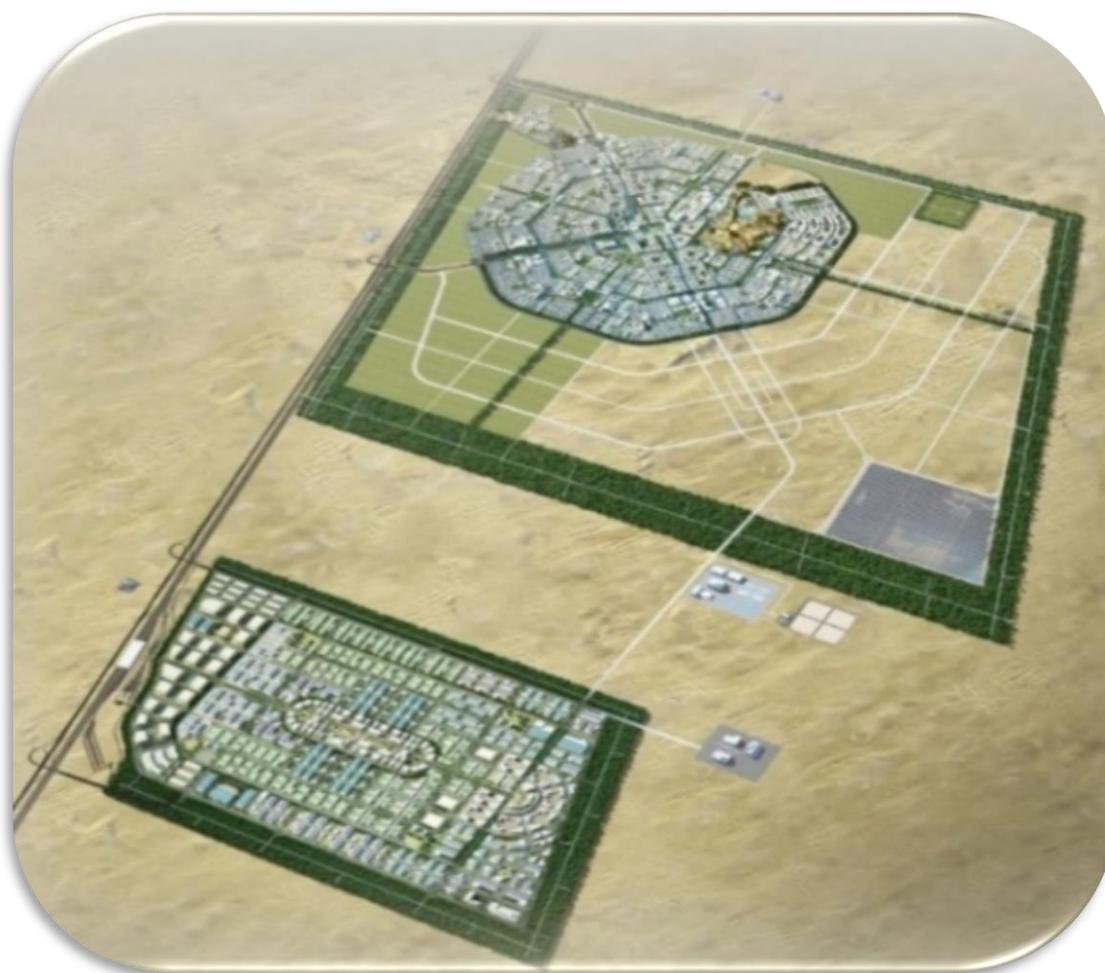
Figure 66 https://www.evnh.wapco.dz/presentation-du-projetzal/ 2023 Fig. 2https://www.evnh.wapco.dz/ville/ .2023

*Figure 67 Plan The new town of Hassi-Messaoud -Ouargla-Algeria(**GROUPEMENT DONGMYEONG , EVNH, 2012***

1.2. The situation of the new city of Hassi Messaoud

A. **Territorial situation:** The new town of Hassi-Messaoud is located in the North East of the Sahara, the commune of Hassi Messaoud is part of the W ilaya of Ouargla, one of the largest wilaya in the country. The project is located about 90 km southeast of Ouargla, the capital of the Wilaya. The project site is located approximately 850 km southeast of Algiers. (GROUPEMENT DONGMYEONG , EVNH, 2012)The wilaya of Ouargla is limited to the north by the Wilaya of El-Oued and El M'Ghair and Touggourt, to the east by Tunisia, to the west by the Wilaya of Ghardaia and El Menia, and south by the wilayas of In Salah and Illizi. (AlAmjed, n.d.)

B. **Regional situation**: Located in the region of Oued El Maraa, the new city is equidistant (about 80 km) from the three surrounding cities namely Ouargla, Touggourt, and the present city of Hassi Messaoud**. **, and is located on the RN3 of PK640+000 to the PK630+400 connecting the RN49 and the RN56. (GROUPEMENT DONGMYEONG , EVNH, 2012),
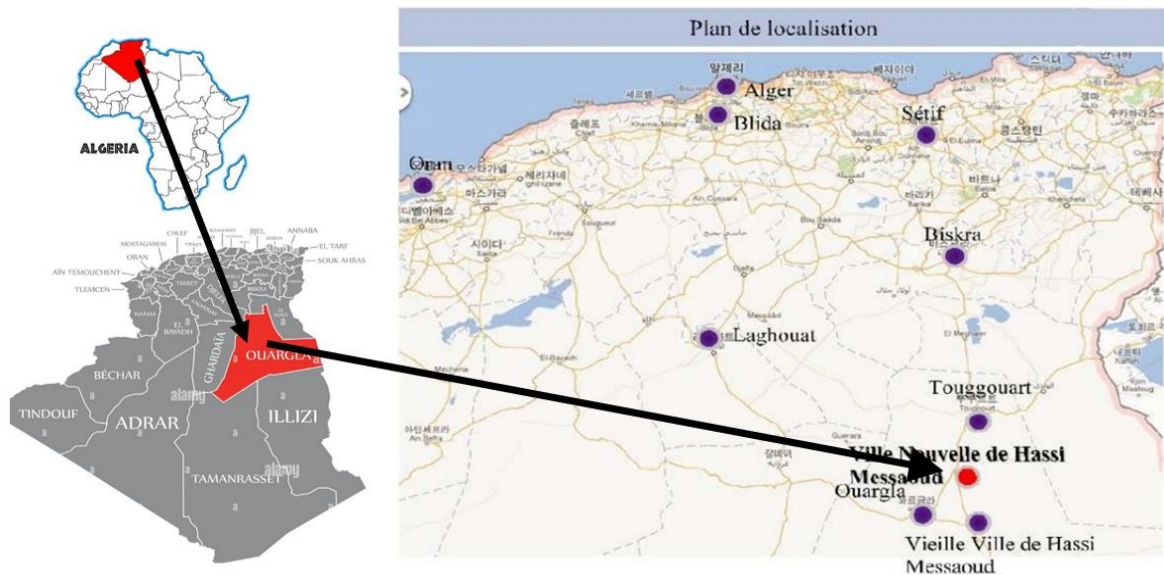
Figure 68Location of the new town of Hassi Messaoud https://pin.it/6aXcoZf , https://www.alamy.com/ouargla-red-highlighted-in-map-of-algeria-image357359497.html , (Hassi Messaoud New Town Development Project (Algeria), 2014)

Figure 69 https://www.evnh.wapco.dz/presentation-du-projetzal/ 2023

1.3. Perimeter of the new city of Hassi Messaoud

The perimeter of the New City covers an area of 4,483 hectares divided into 4 zones of which: 2,044 hectares included in the New City's urbanization and development perimeter;1, 161 hectares for the future urbanization of the city. 313 hectares constitute the perimeter of protection of the new city and 965 hectares are included in the zone of logistic activities (ENVH, 2012)
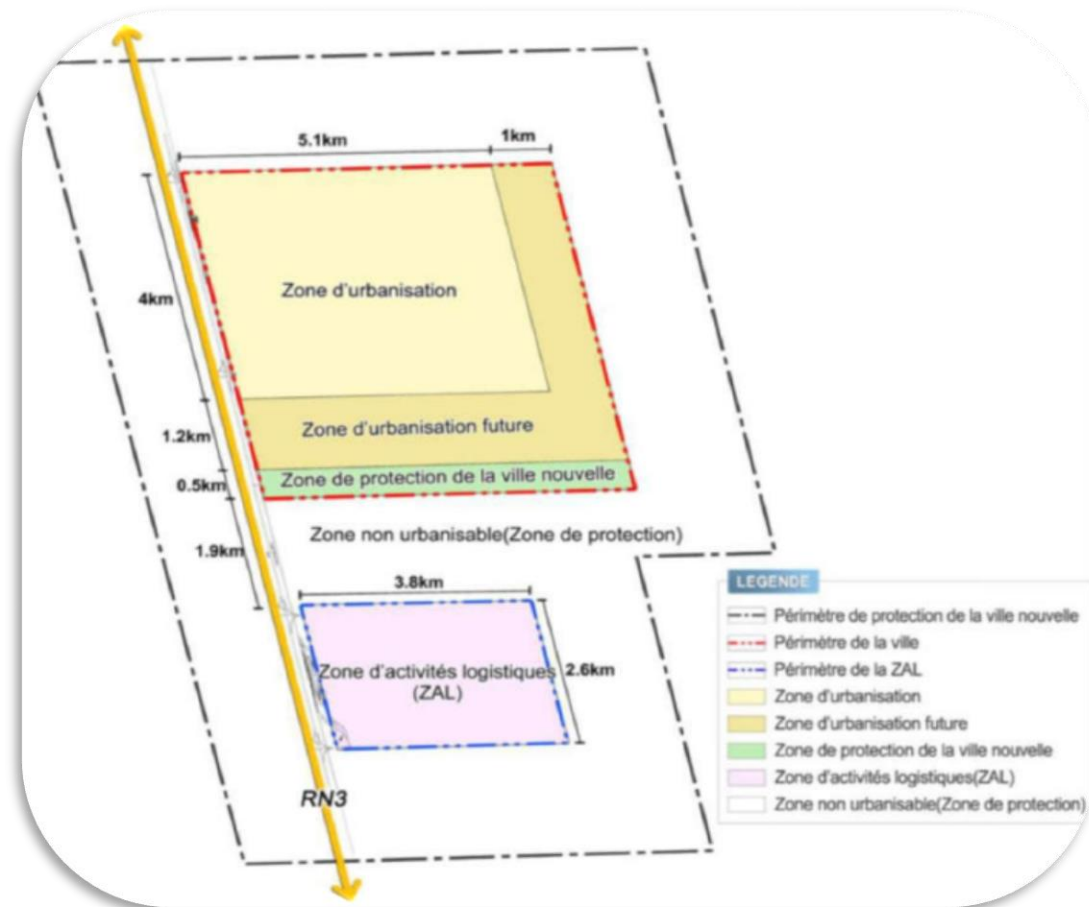
Figure 70 Perimeter of the new city of Hassi Messaoud (GROUPEMENT DONGMYEONG , EVNH, 2012)

1.4. The creation of the new city of Hassi Messaoud

A. **Historical overview of the present city of Hassi Messaoud:** the city is a significant economic center driven by hydrocarbons in Algeria. The city originated from an ancient water well that became its first oil source. In the 1950s, it was classified as an oil city by French colonization, and two major oil companies established their bases near the mining fields. During the 1960s, the city primarily consisted of male workers, and its population remained small. In 1984, it became a commune and experienced rapid urban development, with the construction of commercial, administrative, and residential centers, along with an airport in the hydrocarbon zone. The growth of the city has been characterized by a dynamic and disorderly expansion, with homes built close to oil infrastructure, posing risks to residents and their property. Overall, Hassi Messaoud has transformed from a small oasis

settlement into a modern city centered around the oil and gas industry, bringing both urbanization and economic development, but also technological risks. (Seghiri, 2002) (ville nouvelle de Hassi Messaoud, 2014)

B. **Creation of the city:** The creation of the new town of Hassi Messaoud was mandated by the Algerian government through a decree in 2006, driven by the need to relocate the former city due to significant risks and disasters. The government aimed to develop a new city that is economically, socially, and culturally sustainable, aligning with the National Plan of Spatial Planning (SNAT 2030). The creation of the new town not only ensured the safety of the population but also contributed to the long-term sustainability and development of the region. It rebalanced the territory, provided equitable living conditions, and established an attractive and competitive destination for economic activities. The design of the new city incorporates traditional and modern elements, creating a harmonious environment in the desert. (ENVH, 2012) (Hassi Messaoud New Town Development Project (Algeria), 2014)

1.5. The Establishment of a New Town of Hassi Messaoud: Addressing Technological Risks and Protecting the Population

The decision to establish a new town outside the oil fields in Hassi Messaoud was based on various factors, including preliminary studies on the site and its surroundings. Concerns about the current city being classified as a technological risk zone and its exposure to major accidents prompted the need for a safer alternative. Studies on oil and gas activities highlighted issues such as pollution, waste disposal, and illicit constructions, necessitating the relocation of the city. The establishment of a new town outside the hydrocarbon field aims to mitigate risks, protect the environment, and provide a safer and healthier living environment for the population, while still supporting the vital oil and gas industry in the region. (ENVH, 2012)
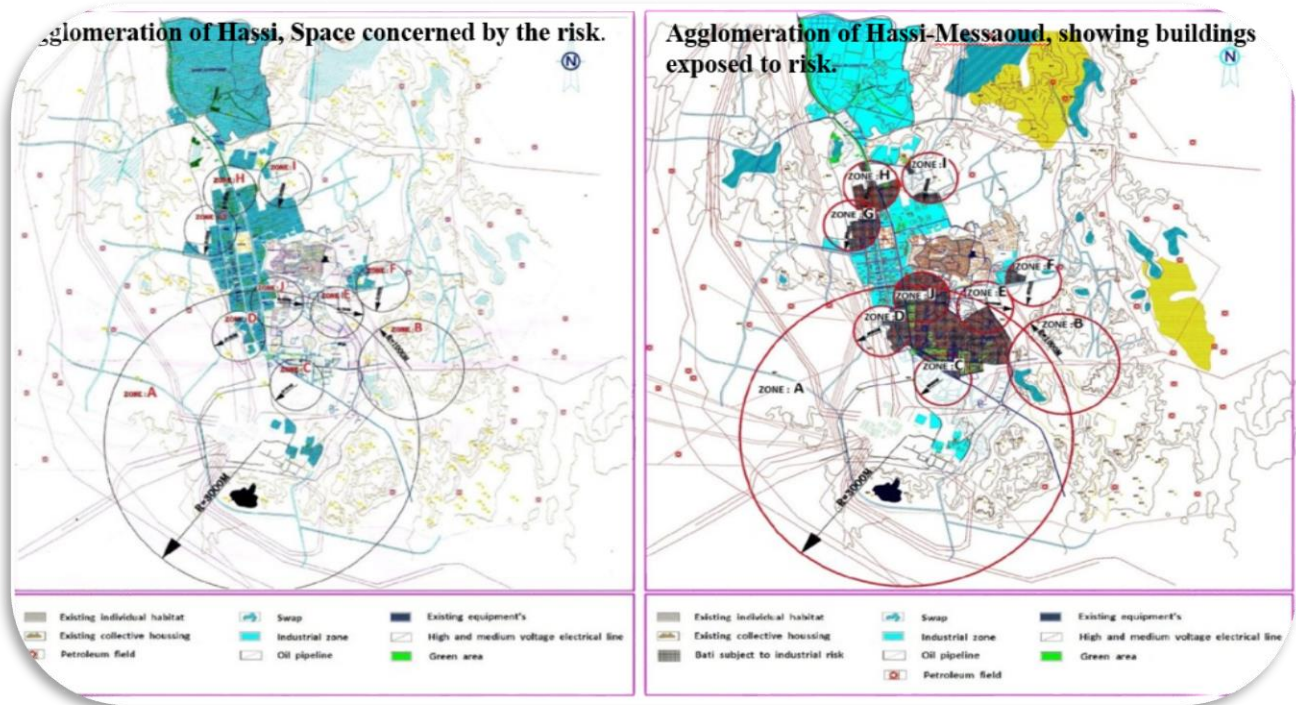
Figure 71https://www.researchgate.net/publication/346941787_Urban_industrial_and_technological_risks_Synthesis_of_the_elements_of_vuln erability_of_the_city_of_Hassi-Messaoud .2023

1.6. The objective of The New Town of Hassi Messaoud project

➢ create a sustainable and dynamic urban environment that balances the use of both fossil fuels and renewable energy sources.
➢ The project aims to consolidate and improve the regional urban infrastructure, providing modern services and amenities to enhance the quality of life for residents.
➢ the project seeks to create a center for sustainable urbanization and development, promoting economic growth and job creation in various sectors.

the goal is to create an urban environment of excellence that addresses environmental concerns and ensures the safety and well-being of the population, while also supporting the important oil and gas industry in the region. (GROUPEMENT DONGMYEONG , EVNH, 2012)

1.7. The vocation of the new city Hassi Messaoud

The vocation of the new city Hassi Messaoud is multi-faceted, with a focus on sustainable development and job creation in the region's economic fabric. The city is designed to complement the existing cities of Ouargla, Touggourt, and the current city of Hassi Messaoud. The new city is expected to create approximately 40,000 jobs and serve as a hub for various sectors, including

➢ Renewable energy.
➢ Research and development.
➢ Agricultural sciences.
➢ Medical and well-being, culture, sport, and leisure.

➢ Support to oil and gas industry.
➢ Logistics and distribution.
➢ Industry (food processing, ICT, and building materials).

The city's logistics area will play a critical role in supporting these functions and ensuring their smooth operation. Overall, the vocation of the new city Hassi Messaoud is to be a model for sustainable urban development and a key driver of economic growth in the region. (GROUPEMENT DONGMYEONG , EVNH, 2012)

1.8. The strategic vision of the new city of Hassi Messaoud

The strategic vision of the new city of Hassi Messaoud can be summarized as

➢ the creation of a sustainable, dynamic, and attractive urban center that supports economic, socio-cultural, and environmental sustainability. The new city aims to promote the economic development of the southern regions of the country by focusing on the energy sector, while also creating an attractive living environment for residents.
➢ In terms of socio-cultural sustainability, the new city aims to provide a unique and excellent living environment in a dry climate, with modern infrastructure and amenities that enhance the quality of life for residents. The goal is to create a vibrant community that fosters social cohesion and cultural diversity.
➢ Environmental sustainability is also a key aspect of the strategic vision for the new city. It aims to be an ecological city that promotes the harmonious coexistence of humans and nature, with a focus on renewable energy sources and sustainable practices that minimize environmental impact.

the strategic vision of the new city of Hassi Messaoud is to create a balanced and sustainable community that supports economic growth, social well-being, and environmental stewardship. (GROUPEMENT DONGMYEONG , EVNH, 2012)

1.9. Concepts for the creation of the new city of Hassi Messaoud

The new city of Hassi Messaoud aims to achieve sustainable development by focusing on four main objectives: economic efficiency, social progress, environmental comfort, and quality of life.

- To achieve economic efficiency, the city will have efficient infrastructure networks, promote renewable energy sources, and foster economic growth.
- Social progress will be promoted by meeting residents' needs, harmonizing traditional and modern elements, and providing access to culture, recreation, and education.
- Environmental comfort will be ensured through waste recycling and treatment, reducing greenhouse gas emissions, promoting energy savings, and sustainable housing.
- The quality of life will be enhanced by creating human-scale living spaces, adapting to the Saharan climate, offering diverse urban functions, and encouraging sustainable modes of transportation. (ville nouvelle de Hassi Messaoud, 2014)

2. Analysis of the new Town of Hassi Messaoud:
2.1. Accessibility to the new Town of Hassi Messaoud:

The project site for the new town of Hassi Messaoud has good accessibility with favorable road and transport conditions. Several projects have already begun, including railway lines connecting Touggourt to Hassi Messaoud and the new town of Hassi Messaoud to Ouargla. The location is situated at the intersection of the N-S road connecting Biskra, Touggourt, El Oued, Tamanrasset, and Illizi, as well as the O-E road linking Ouargla and Ghardaïa. In addition, the construction of a highway between Hassi Messaoud and Ouargla (20km) and a 274km long road linking Ouargla to El Goléa, planned in SRAT 2009, will further improve the road conditions of the new city. The new city will also be served by the airports of Touggourt, Ouargla, and the present city of Hassi Messaoud. (GROUPEMENT DONGMYEONG , EVNH, 2012)

2.1.1. Accessibility to the new Town of Hassi Messaoud, the role of doors:

When you want to enter a city, you usually go through some sort of entrance, right? These entrances are often referred to as "doors", which is a symbolic nod to how traditional cities were built. By creating doors that connect the new city to the surrounding urban areas, it's hoped that the new city will become more integrated into the region as a whole.

   a. **The city** has three doors designed as an interface between the city and its territory:
  - ➢ Two doors that connect the city to the RN 3 highway
  - ➢ One door from the train station

   b. **The ZAL (Logistics Activity Zone)** has:
  - ➢ Two doors that connect the ZAL to the RN 3 highway
  - ➢ One door from the train station

By having these doors, it's easier for people to get in and out of the city, and for goods to be transported in and out of the logistics zone. It's all about making the city more accessible

Figure 72 The entrance gates to the new town of Hassi Messaoud Source prepared by the student

2.2. The geographical context of the new town of Hassi Messaoud:

A. Climate: The weather stations located in Touggourt, Ouargla, and Hassi Messaoud have gathered important data that is necessary for the study of the climate in the new city. Here's a summary of what has been gathered so far by (GROUPEMENT DONGMYEONG , EVNH, 2012):

a. The wind: When it comes to wind patterns, an analysis of data from the three weather stations near the new city shows the following:

➢ The predominant wind direction in Hassi Messaoud and Touggourt is from the east, while in Ouargla it is from the north.

➢ Warm winds usually blow from the south, while moderate winds come from the north and northeast between January and June, and from October to January.

➢ Sand storms are relatively common in the area, with high-speed winds occurring frequently from February to May and from August to November. These sand storms typically last for up to 10 days per year.
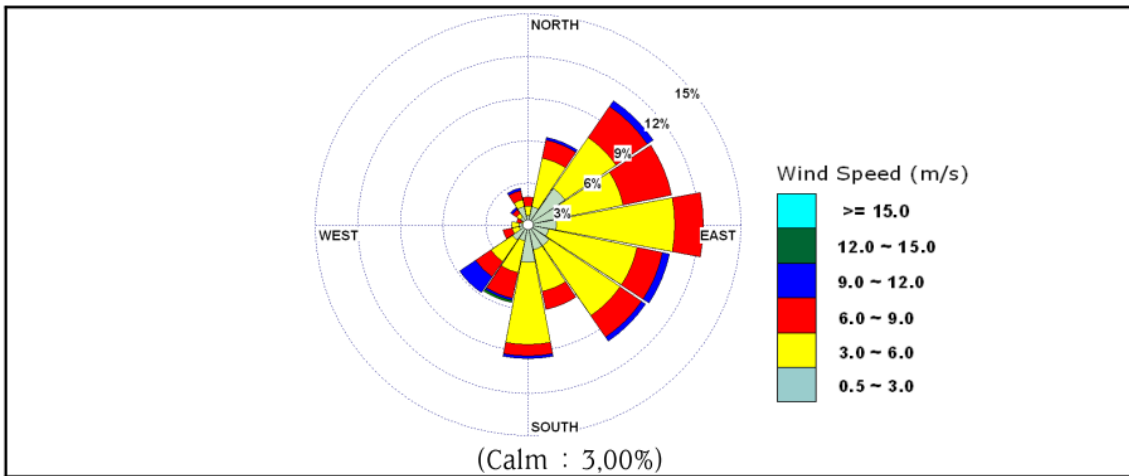
Figure 74 Hassi Messaoud Wind Rose (Annual) (GROUPEMENT DONGMYEONG , EVNH, 2012)
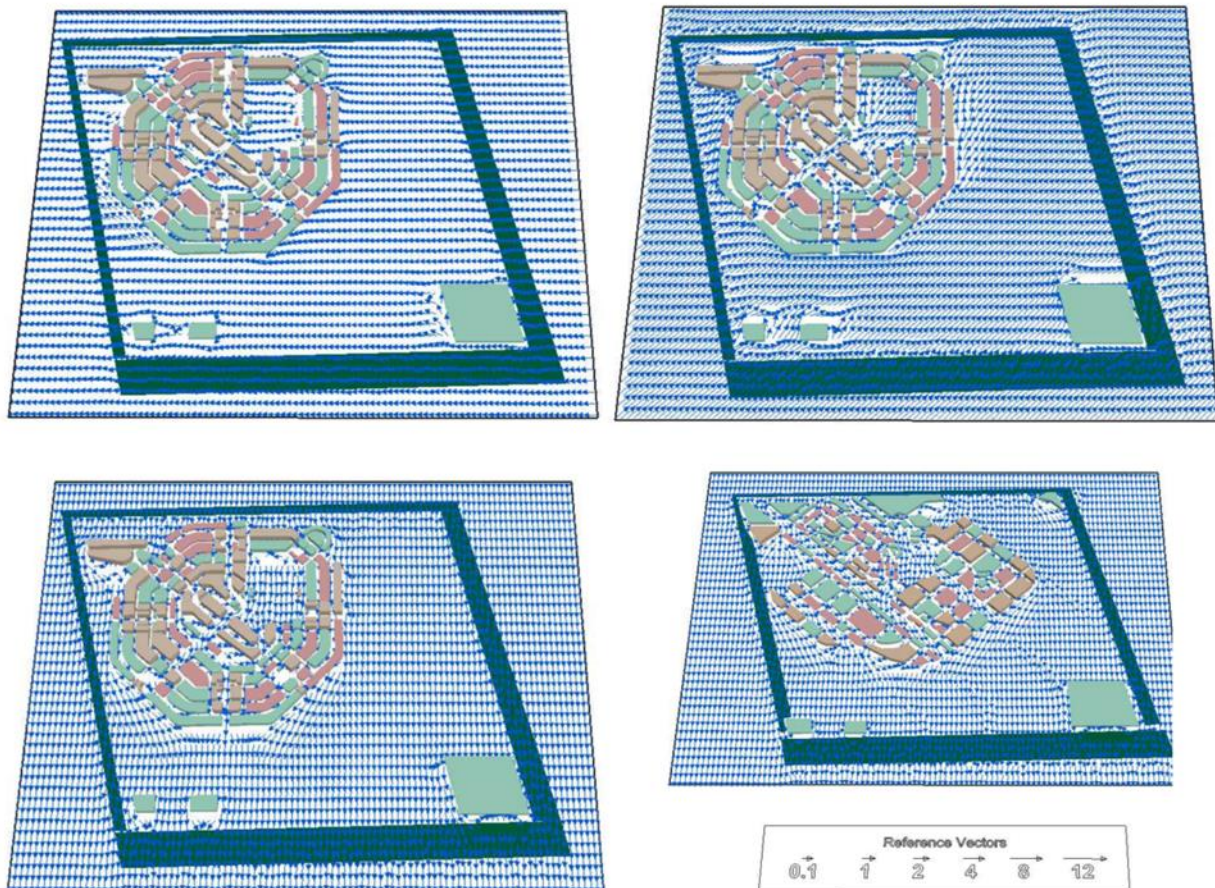
Figure 73 Distribution of the wind field (GROUPEMENT DONGMYEONG , EVNH, 2012)

b. The temperature: According to temperature data collected at Hassi Messaoud, the monthly average temperature ranges from 11.3°C in January to 34.5°C in July. This indicates a significant difference in temperature between the winter and summer months, with a thermal amplitude of up to 23.2°C between the minimum and maximum temperatures.
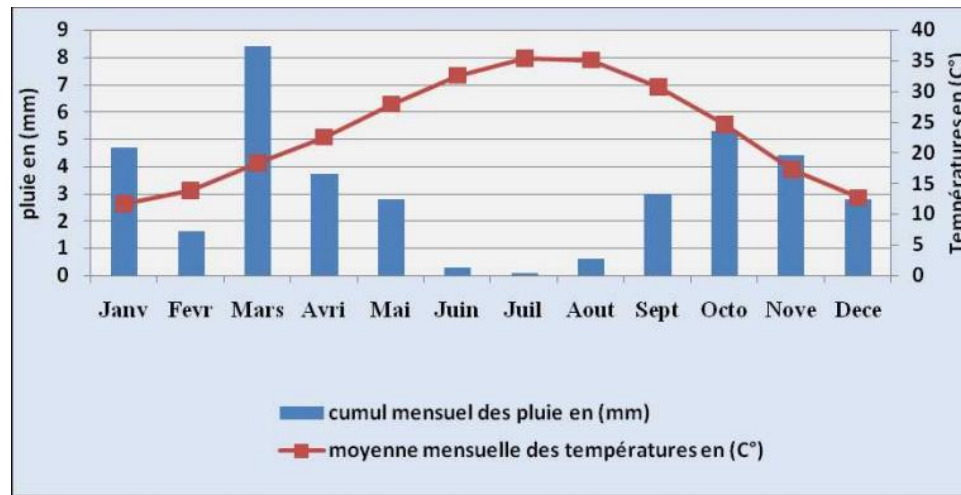
Figure 75 Homoeothermic diagram for the Hassi-Messaoud weather station (GROUPEMENT DONGMYEONG , EVNH, 2012)
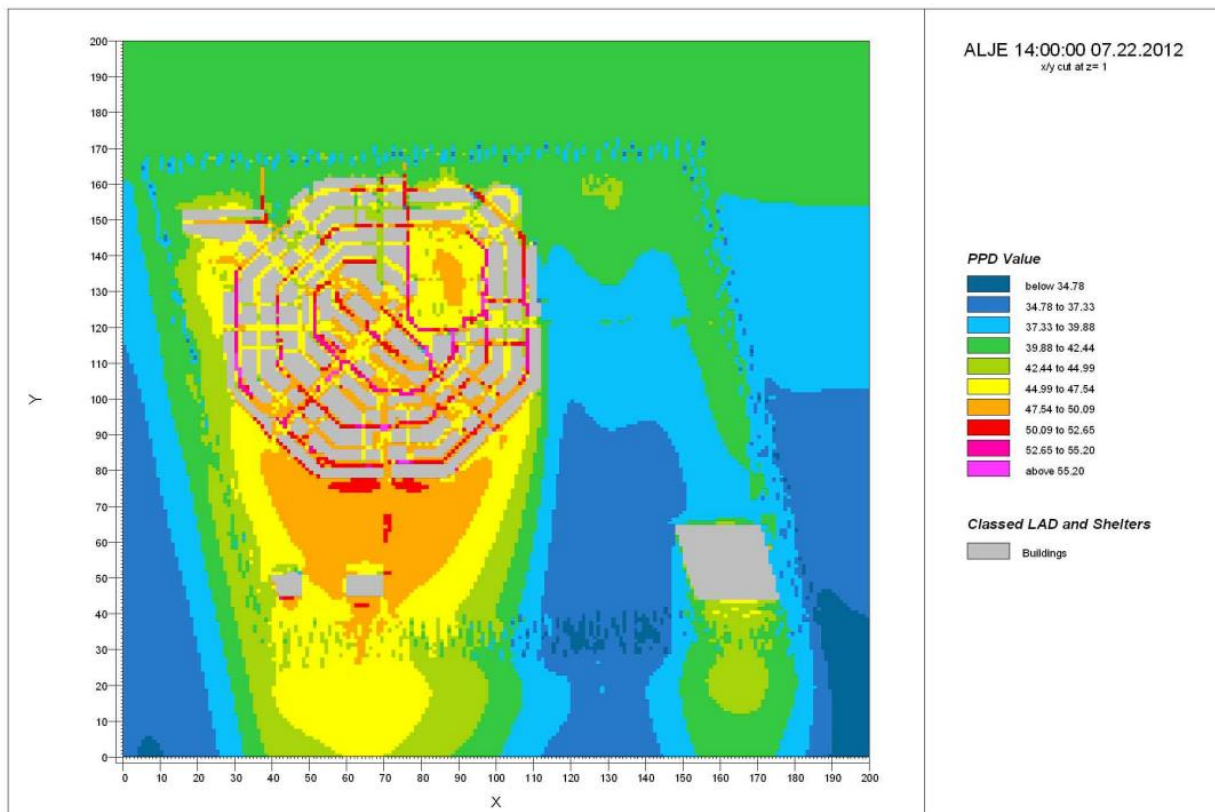
Figure 76 PPD value felt by a moving pedestrian (2 p.m.: Case 07)) (GROUPEMENT DONGMYEONG , EVNH, 2012)
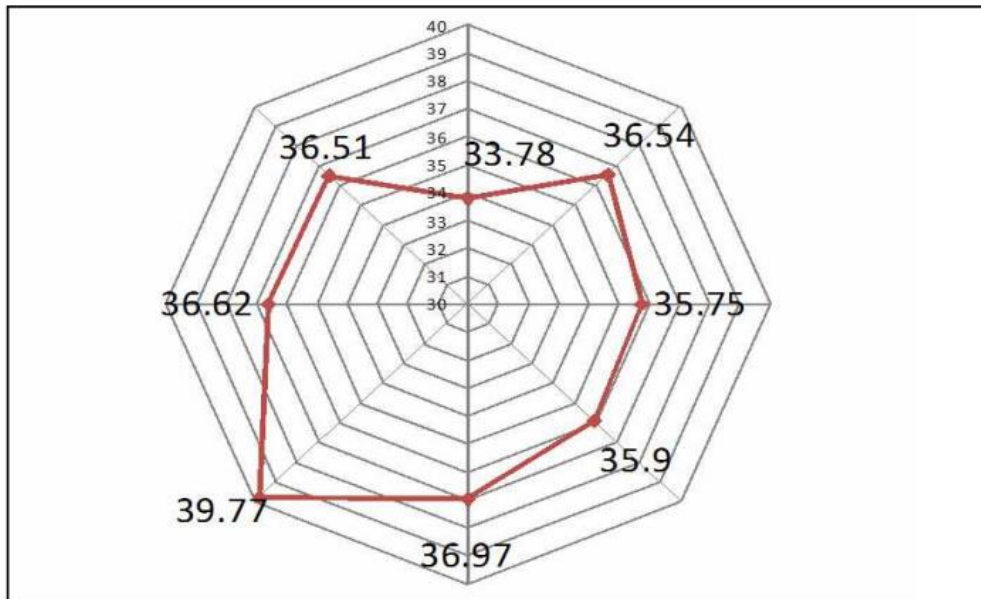
Figure 77Temperature by wind direction at the project site (℃) (GROUPEMENT DONGMYEONG , EVNH, 2012)

The maximum temperature of the southwest wind is 39.77℃ and the minimum temperature of the north wind is 33.78℃. The difference between the values is about 6

c. **Moisture:** The monthly average humidity levels in the region vary throughout the year. The humidity range is from a low of 23% in July to a high of 60% in December, with the highest mean maximum humidities observed in January (59%) and December (60%). In contrast, the lowest mean minimum humidities are typically observed in July (23%). It's important to note that humidity levels can vary greatly depending on the time of day and local weather conditions, and can have a significant impact on the local climate and environment.
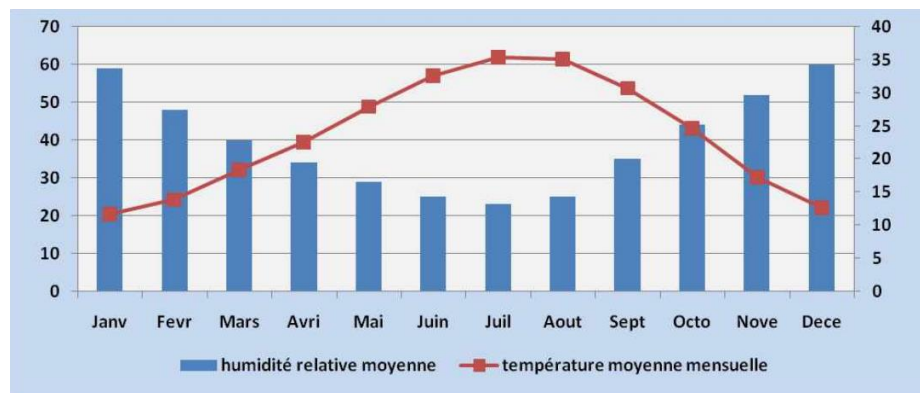
Figure 78 Homoeothermic diagram for the Hassi-Messaoud weather station (GROUPEMENT DONGMYEONG , EVNH, 2012)

d. **Precipitation:** the monthly rainfall totals in Hassi Messaoud range from 0.2mm in July to 7.8mm in March. the annual rainfall totals don't exceed 40mm, the lowest rainfall is in July, which also happens to be when the temperature is at its lowest point.

Année	Janvier	Février	Mars	Avril	Mai	Juin	Juillet	Août	Septembre	Octobre	Novembre	Décembre
2011	15,1	4,9	9,6	7	3,6	1,6	0,4	1,9	4,4	5,1	8,1	5,3

Fig 1Monthly rainfall statistics in mm (GROUPEMENT DONGMYEONG , EVNH, 2012)
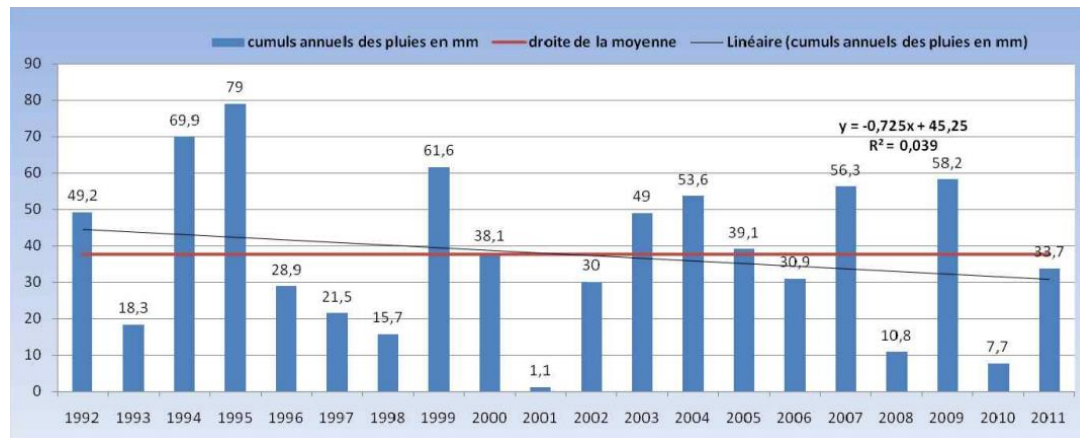
Figure 79 Temporary evolution of the rains at the station of HASSI MESSAOUD period 1992 2011 (GROUPEMENT DONGMYEONG , EVNH, 2012)

Synthesis: The new town of Hassi Messaoud is located in an arid climate zone, characterized by permanent drought, high temperatures, and intense sunlight throughout most of the year. The region also experiences irregular and scarce precipitation, leading to a high rate of evaporation. As a result, the climate-related natural hazards in the city include silting, temporary flooding, and drying out. Appropriate protection measures are required to mitigate these risks.

B. **Geomorphology:** The area is part of the great eastern erg, characterized by a monotonous landscape of fixed dunes shaped by continuous wind erosion. The territory of Ouargla has various relief features, including the great eastern erg, the stony plateau of Hamada, fossil valleys, and plains. The surface layers are composed of sand or sandy loam, and the geology is marked by an anticline oriented along a southwest/northeast axis. The rock layer mainly dates back to the Quaternary and Eocene periods.

  ➢ **Quaternary elements:** generally, have a thickness ranging from 0 to 20 m and are composed of gypsum or clayey sand.
  ➢ **Mousterian elements:** present a sedimentary layer of average thickness of 200 m and is composed of sand, limestone rock, and clay.
  ➢ **Eocene elements:** have an average thickness of close to 120 m and are composed of dolomite and flint.

(GROUPEMENT DONGMYEONG , EVNH, 2012)
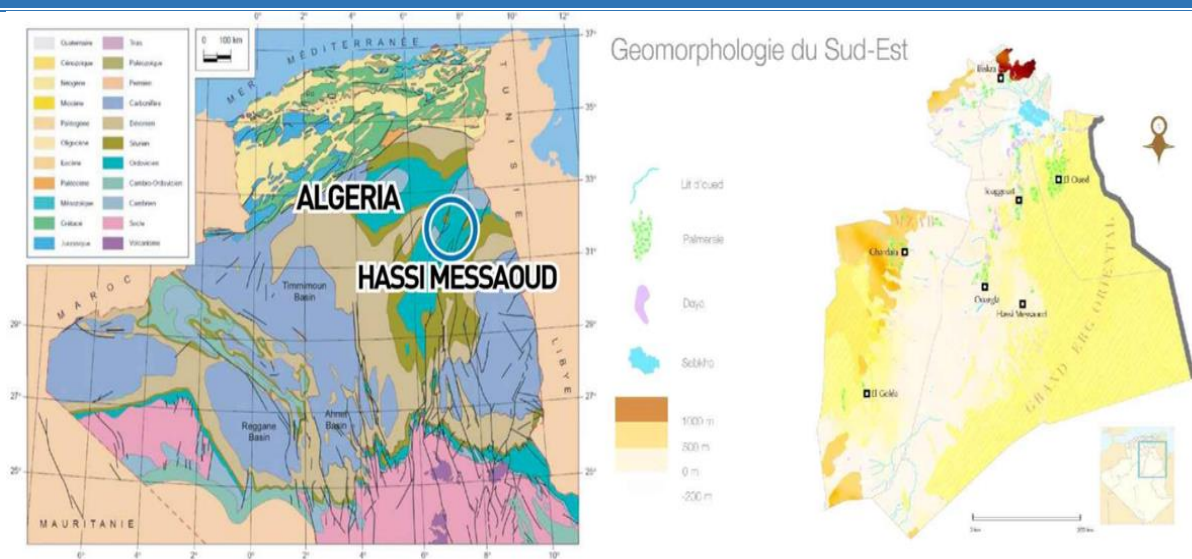
Figure 80 (GROUPEMENT DONGMYEONG , EVNH, 2012)

C. **Topography:** The topography of the new town of Hassi Messaoud is generally flat and situated at an altitude of around 120 meters. The site does not have any Wadi tracks, but dunes can be found from the northeast to the southwest of the area. The dunes in the northeast are higher than those in the southwest. (GROUPEMENT DONGMYEONG , EVNH, 2012)
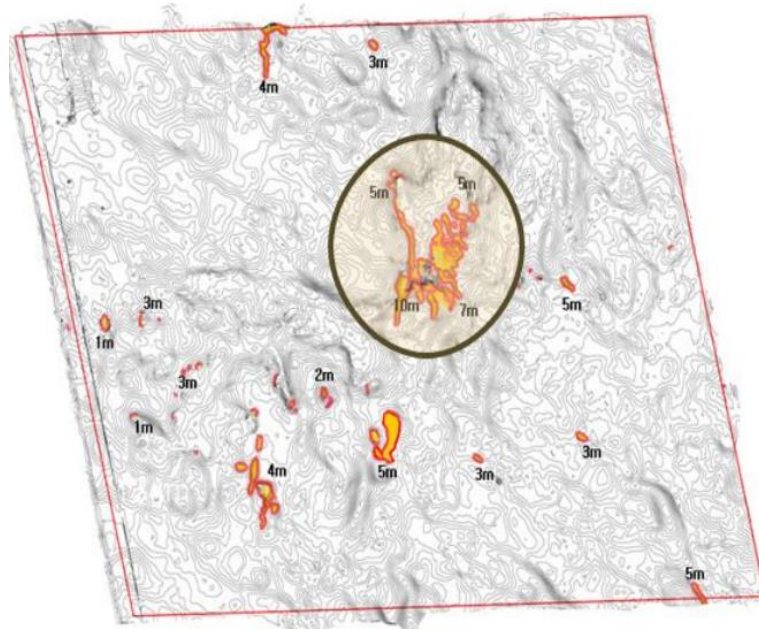
Figure 81 The topography of the new town of Hassi Messaoud (GROUPEMENT DONGMYEONG, EVNH, 2012)

D. **Hydrography:** The hydrogeological study of Hassi Messaoud new town reveals substantial underground water resources that can meet water demands until 2050. These resources are part of the Northern Sahara Aquifer System, particularly the CT-CI aquifers. The CT-CI aquifers are considered fossil and comprise the Terminal Complex and Intercalary Continental formations.

The CI aquifer is deep and characterized by high temperature and low salinity, while the CT aquifer is closer to the surface.

To ensure the long-term availability and quality of these water resources, rational management practices are crucial. Reusing treated wastewater can also help conserve conventional water sources. Careful monitoring of water quality is necessary for their safe and efficient utilization. The hydrogeological study emphasizes the importance of sustainable water management to protect these underground water resources for future generation. (GROUPEMENT DONGMYEONG , EVNH, 2012)
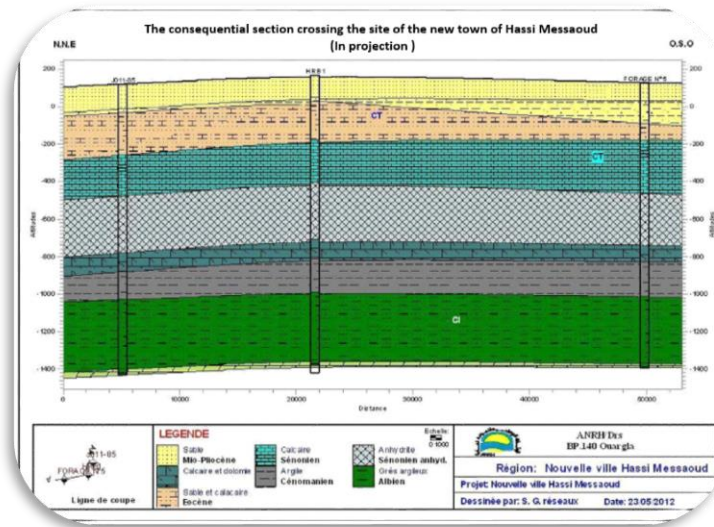
Figure 82 (GROUPEMENT DONGMYEONG , EVNH, 2012)

E. **Seismicity:** the available information from sources such as USGS, CGS, and RPA 2003 suggests that the study area is subject to the lowest seismic hazard, categorized as Zone 0 with a very low or negligible seismic hazard. There are no known geotechnical hazards such as landslides, collapses, cavities, falls, or liquefactions identified in the area. Furthermore, during geotechnical investigations, no faults have been observed in different project areas.
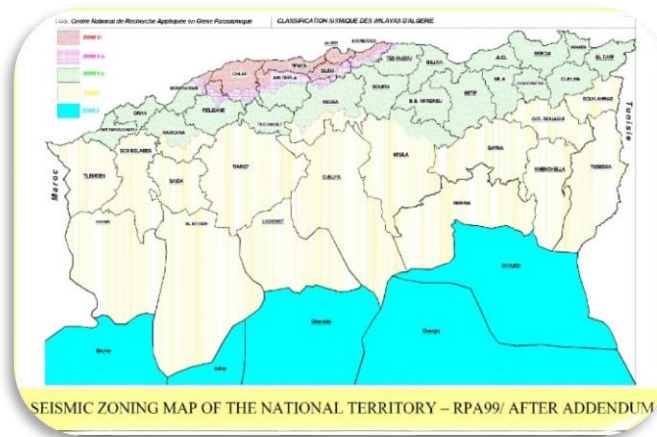
Figure 83http://www.uploads.indesengineering.com/FIVES_CHL1_transfer%20towers/Algeria%20code/RPA99%20VERSION%2 02003%20Carte%20zonage%20sismique%20d'Algerie.pdf .2023

2.3. The principles of urban composition:

The new city of Hassi Messaoud is organized around the concept of an Urban Oasis, blending modern and traditional South Algerian elements while respecting the desert environment. It features four residential districts surrounding a central city center. The center is formed by intersecting axes that cater to economic, business, administrative, and cultural functions, with a central barrier providing leisure amenities. The city follows a conventional urbanism model, with a central business district, high-density housing, and low-density housing in outer areas. The design achieves a harmonious balance between modern urban needs, cultural values, and the desert environment's unique characteristics.
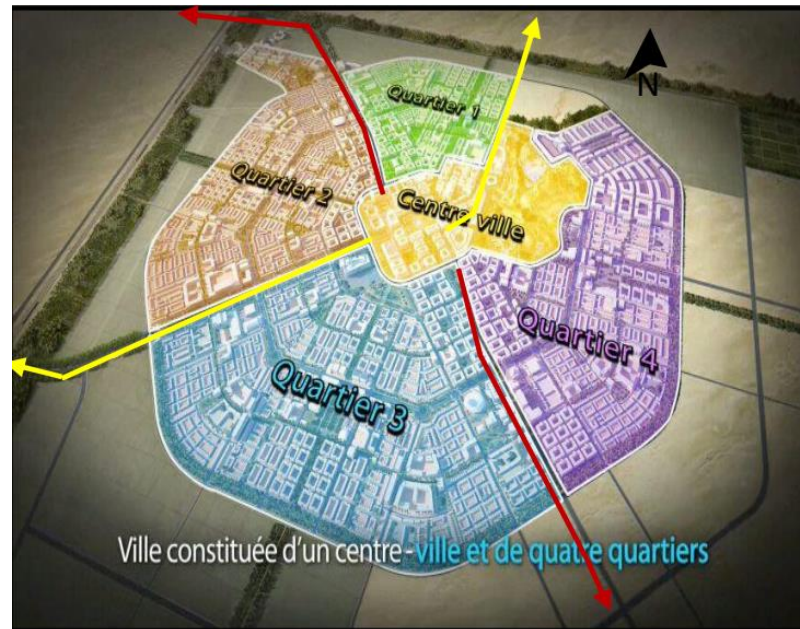
Figure 84 Map of the town of city Hassi Massoud (GROUPEMENT DONGMYEONG , EVNH, 2012)

A. **Distribution of urban units:** The distribution of urban units in the new city of Hassi Messaoud follows a basic principle of designing self-sufficient living units with daily amenities that can be accessed without the need for mechanical modes of transport. These living units are grouped together to form neighborhoods, which in turn make up the four districts of the city. (GROUPEMENT DONGMYEONG , EVNH, 2012)

Figure 85 (GROUPEMENT DONGMYEONG , EVNH, 2012)

The size and spatial composition of each urban unit are taken into consideration, as well as the distribution of urban functions such as housing, commerce, and public spaces. The development of these units is also planned in stages to ensure that the city grows in a sustainable manner.

The organization of the city into four districts is based on the actual shape of the city and the distances from the facilities. This ensures that each district has access to essential services and amenities, while also promoting a sense of community and belonging among its residents. (GROUPEMENT DONGMYEONG , EVNH, 2012)
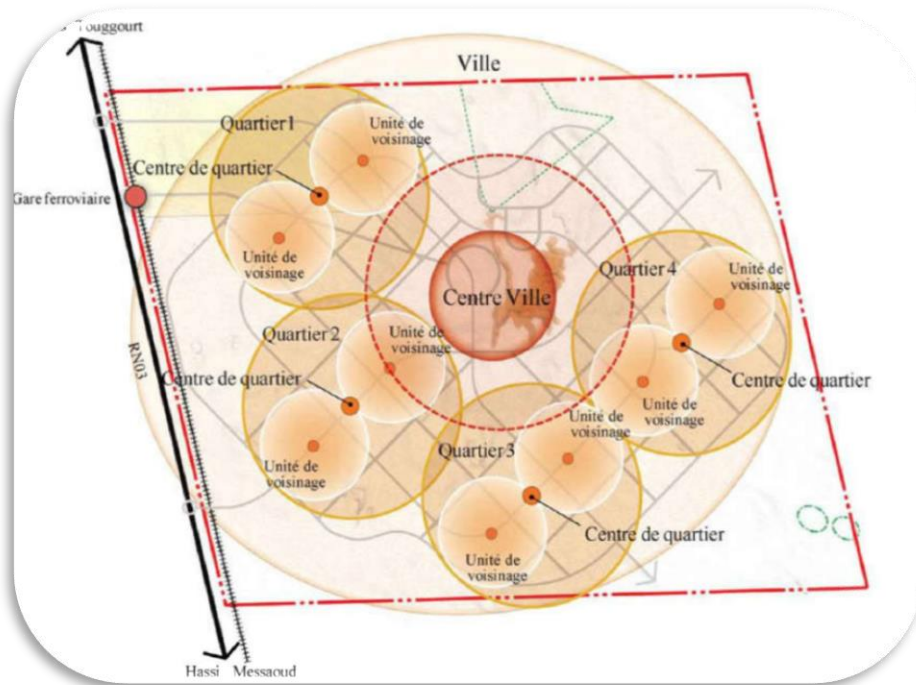
Figure 86 Distribution of urban units (GROUPEMENT DONGMYEONG , EVNH, 2012)
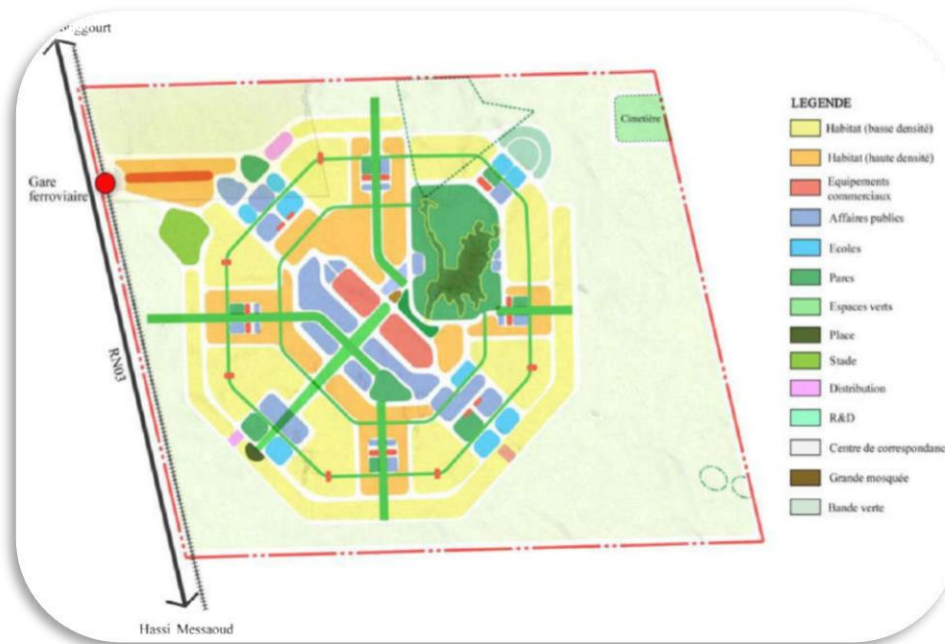
Figure 87 Composition and typologies of urban fabrics V1 (GROUPEMENT DONGMYEONG , EVNH, 2012)

Figure 88 Composition and typologies of urban fabrics v 2 (GROUPEMENT DONGMYEONG , EVNH, 2012)

B. Creation of the different urban axes: The urban design of the new city of Hassi Messaoud includes the creation of two major axes: a green urban axis and a development axis, which intersect perpendicularly. The green axis connects the area of sand dunes in the central part of the southwest axis, and two proposed variants have been suggested for the intersection of the axes.
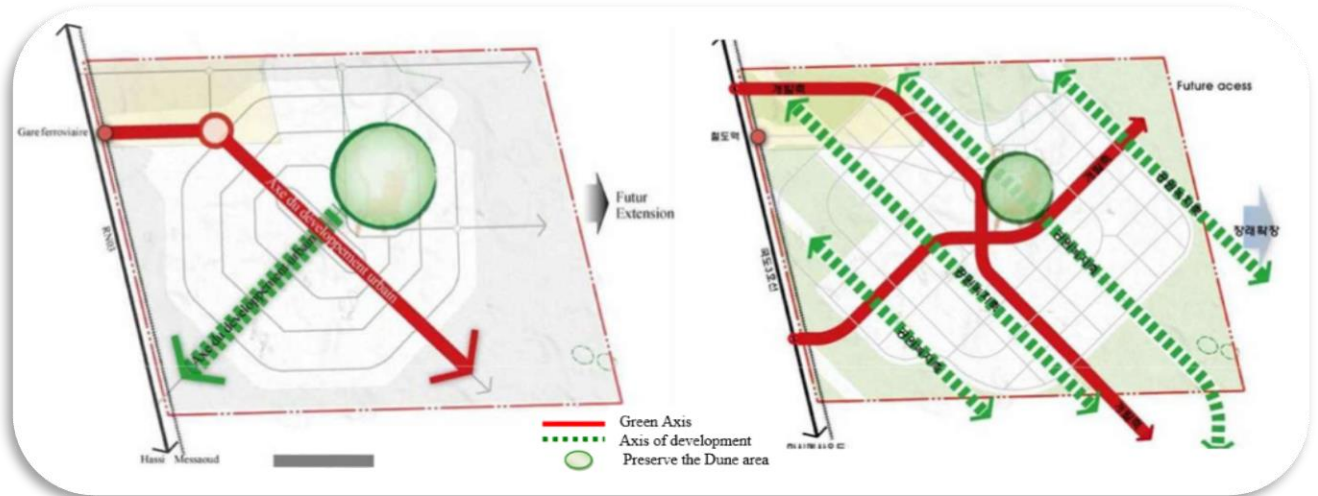
Figure 89 The different urban axes (GROUPEMENT DONGMYEONG , EVNH, 2012)

To ensure the continuity of the urban landscapes and avoid any interruptions in pedestrian or mechanical routes, perspectives are projected with urban events such as green spaces and quality buildings. The major road and urban transportation system is based on the structural road axes that intersect perpendicularly, linking the main urban functions together.
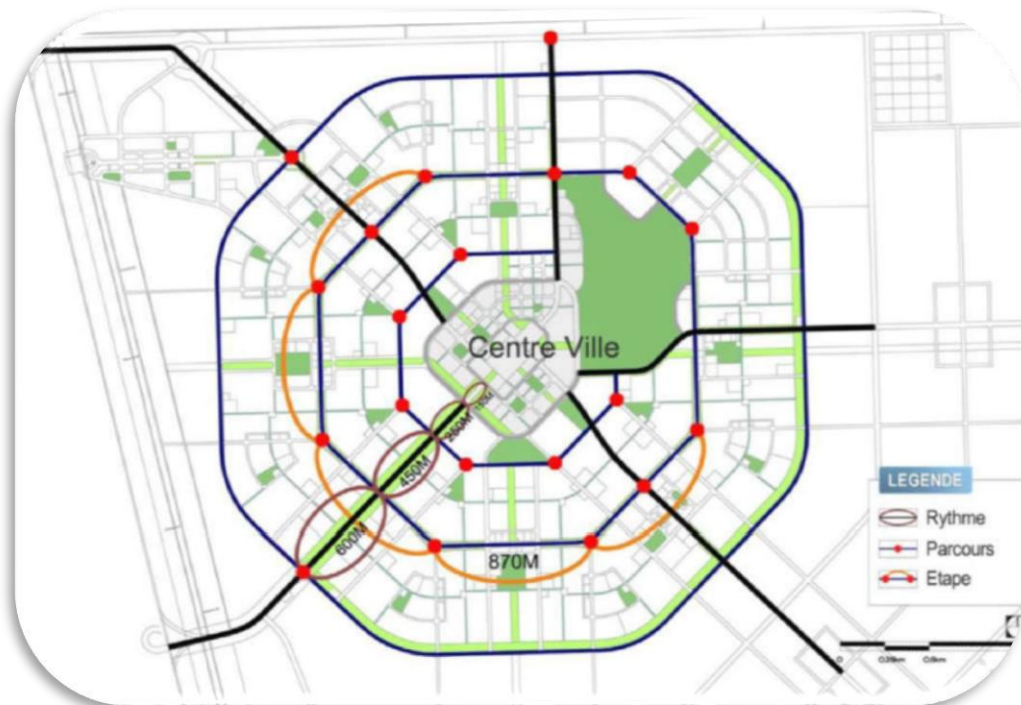
Figure 90 The rhythm and course of the city (GROUPEMENT DONGMYEONG , EVNH, 2012)

Variant 1 includes an organization of a curved mesh road structure and the creation of two links between the city and the region. Variant 2 involves the design of a shaded urban structure and the location of two points of articulation for the city with the region through the connection of axes of urban structuring. (GROUPEMENT DONGMYEONG , EVNH, 2012)
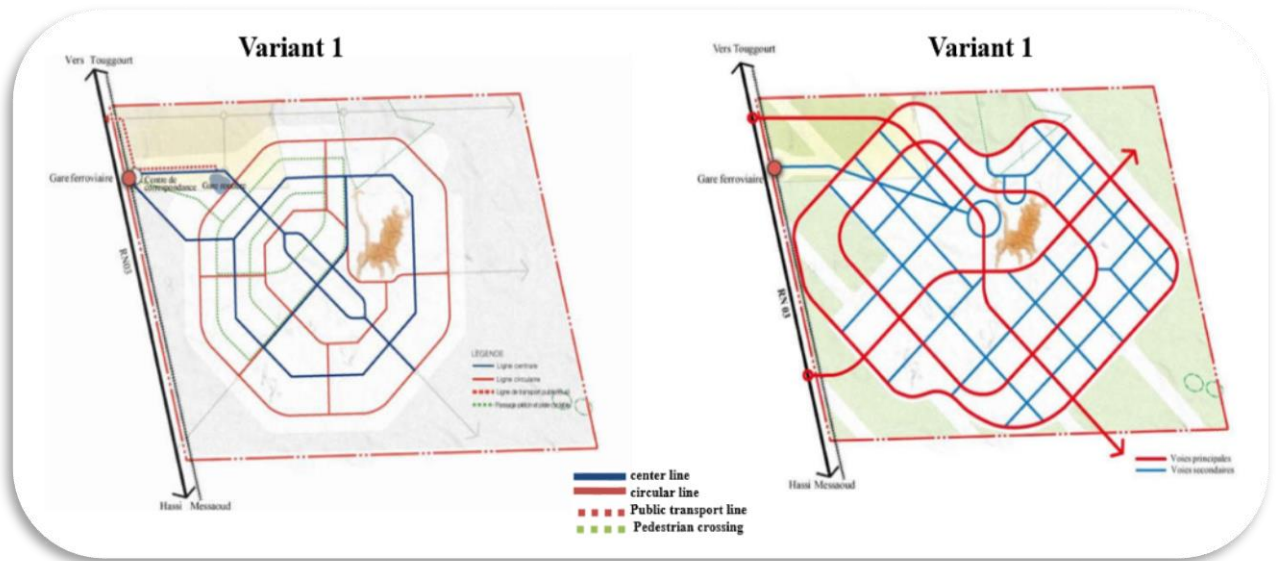
Figure 91 Type of road (GROUPEMENT DONGMYEONG , EVNH, 2012)
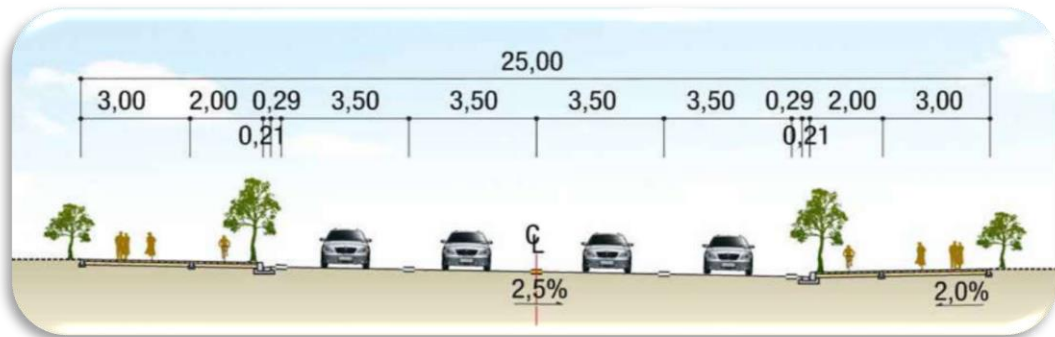
Figure 92 Type of a Main Road (public transport axis) (Variants 1 and 2) (GROUPEMENT DONGMYEONG , EVNH, 2012)
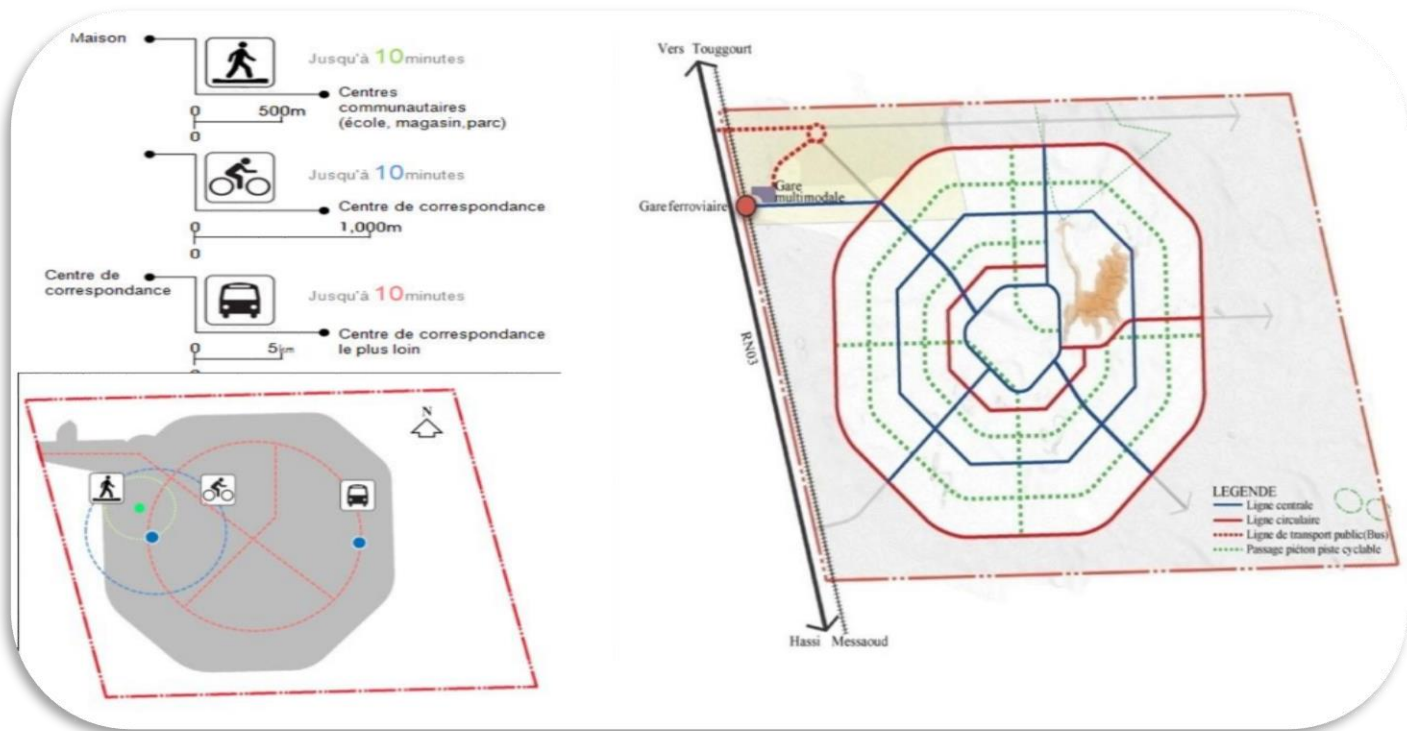
Figure 93 Organization of the public transport network (GROUPEMENT DONGMYEONG , EVNH, 2012)

C. **Shading in relation to the urban axis:** The urban axis in Hassi Messaoud is designed to provide shading to the streets for more than 3 hours per day. This is based on simulation studies that take into account the elevation of the buildings and the azimuth angle of the sun. The streets are oriented at a 45-degree angle with respect to the north direction, which helps to create shaded areas during the day. This is an important consideration in a hot and arid climate like Hassi Messaoud, as shading can help to reduce the heat island effect and provide more comfortable outdoor spaces for residents. (GROUPEMENT DONGMYEONG , EVNH, 2012)
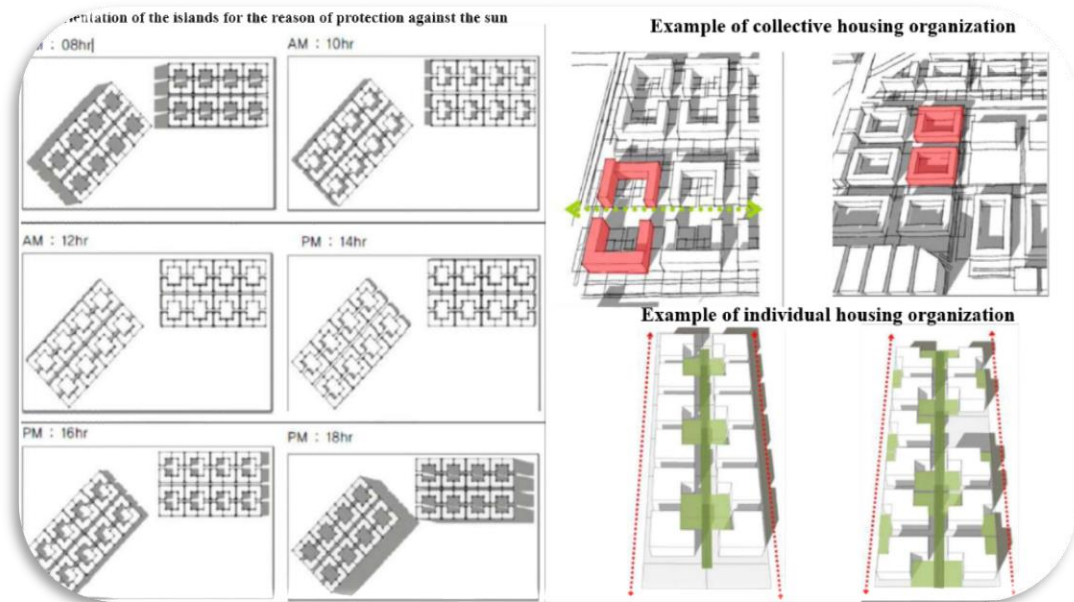
Figure 94 (GROUPEMENT DONGMYEONG , EVNH, 2012)

D. Parks and green spaces: In the new city of Hassi Messaoud, creating parks and green spaces is a top priority for urban planners. The central park acts as the focal point, embodying the concept of an "oasis city." To combat strong southern winds and harness cooler northern winds, a hierarchical system of green axes has been implemented. These axes serve as vegetative screens and channels for wind flow. The integration of agricultural production perimeters helps stabilize sand dunes, while plant hedges and windbreaks are strategically placed to connect the city with the surrounding region. High-rise community housing is designed to mitigate wind speeds. In the Saharan zone, a protective green strip has been established to shield the city from warm winds and prevent silting. The strip spans 6 km in length and 500 m in width, comprising various grasses and tree species. This green strip plays a crucial role in creating a sustainable and livable environment in Hassi Messaoud new city. (GROUPEMENT DONGMYEONG , EVNH, 2012)

Location of parks and green spaces

Variant 1

Variant 2
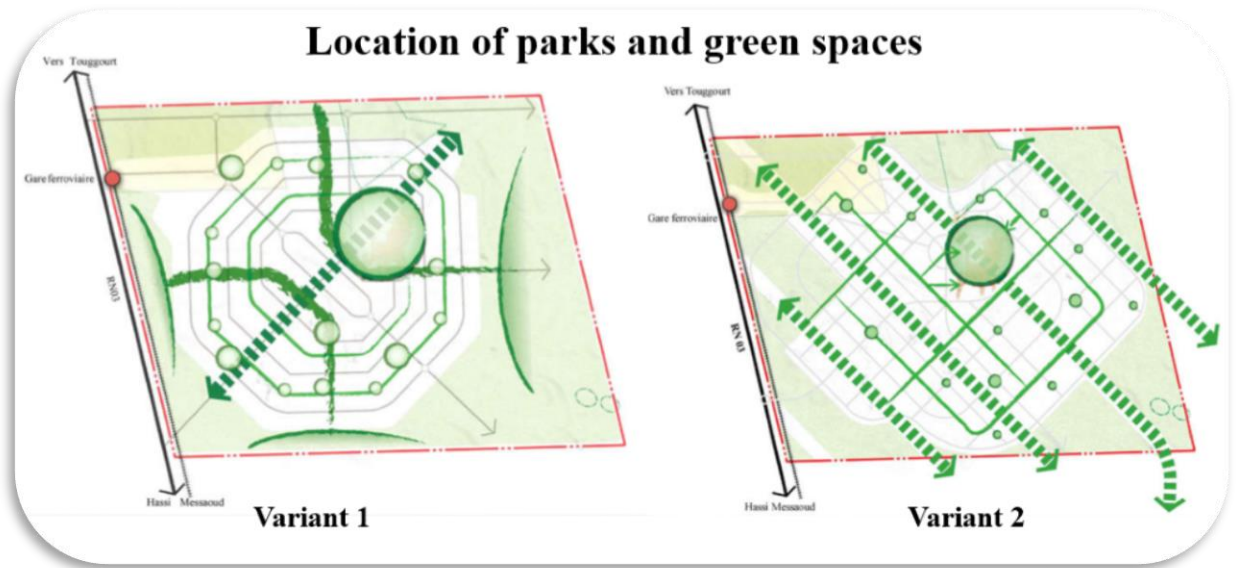
Figure 95 (GROUPEMENT DONGMYEONG , EVNH, 2012)
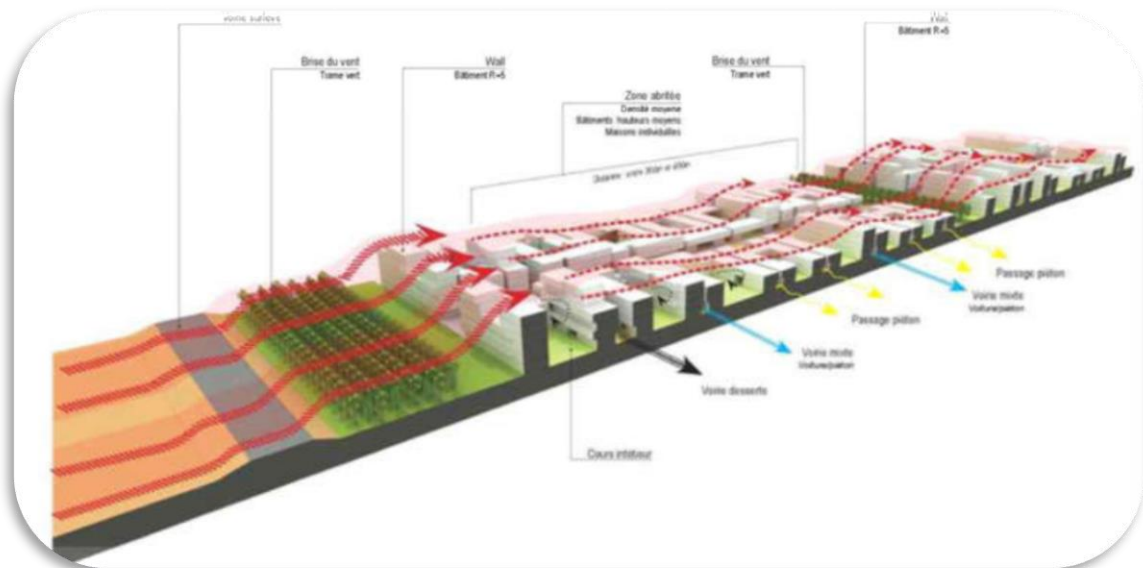
Figure 96 The green strip of the new town (GROUPEMENT DONGMYEONG , EVNH, 2012)

Figure 97 Green strip https://www.evnh.wapco.dz/le-bande-verte/ .2023

Water bodies have also been included in the city's design, such as the creation of large aquatic spaces at the central park and the development of suitable aquatic spaces in open spaces throughout the city. Water channels have been constructed along the green axis and connected to other aquatic areas to build the blue climate regulation network. (GROUPEMENT DONGMYEONG , EVNH, 2012)

a. Different types of aquatic spaces:

The urban plan proposes the creation of a Compact Water Scape that comprises different types of aquatic spaces, including lines, surfaces, and points.

- ➢ **Line Water Channels:** These are linear-type aquatic spaces that serve multiple functions such as connecting different types of aquatic spaces, regulating the urban climate, consolidating the quality of the living environment and the economy of water, and creating high-quality relaxation areas and serenity through the sounds released by the flow of water.
- ➢ **Surface:** Lakes: Central aquatic spaces that create spaces for walks and relaxation, while consolidating the concept of the city as an "Urban Oasis", creating strong urban landmarks, and regulating the urban climate.
- ➢ **Point**: water jet Dynamic and pleasant aquatic spaces of different types that create urban landmarks at the level of road network joints, enhance them, support urban dynamics, and allow users to have direct contact with water, participate in the regulation of the urban climate, and save water through the regulation of their flow during hours of intense sunshine.

(GROUPEMENT DONGMYEONG , EVNH, 2012)

Figure 98 Types and forms of aquatic spaces (GROUPEMENT DONGMYEONG , EVNH, 2012)

b. Protection against intense solar radiation: To protect against intense solar radiation, the urban plan proposes the design of economic elements such as shaded areas that provide

protection against the sun. The generalization of the development of shaded areas is proposed to ensure the comfort of pedestrians and the regulation of the urban climate. (GROUPEMENT DONGMYEONG , EVNH, 2012)

E. **Waste management:** The waste management plan in Hassi Massoud focuses on environmental protection and sustainable practices. It includes wastewater treatment, recycling, waste collection, sorting, and disposal. Organic waste is composted for soil improvement, while inorganic waste is sorted for recycling or disposal in landfills. Awareness campaigns and public recycling bins encourage waste reduction and recycling. Measures are also in place to control illegal dumping and littering. Overall, the plan aims to minimize the environmental impact of waste and promote sustainability in Hassi Massoud. (GROUPEMENT DONGMYEONG , EVNH, 2012)
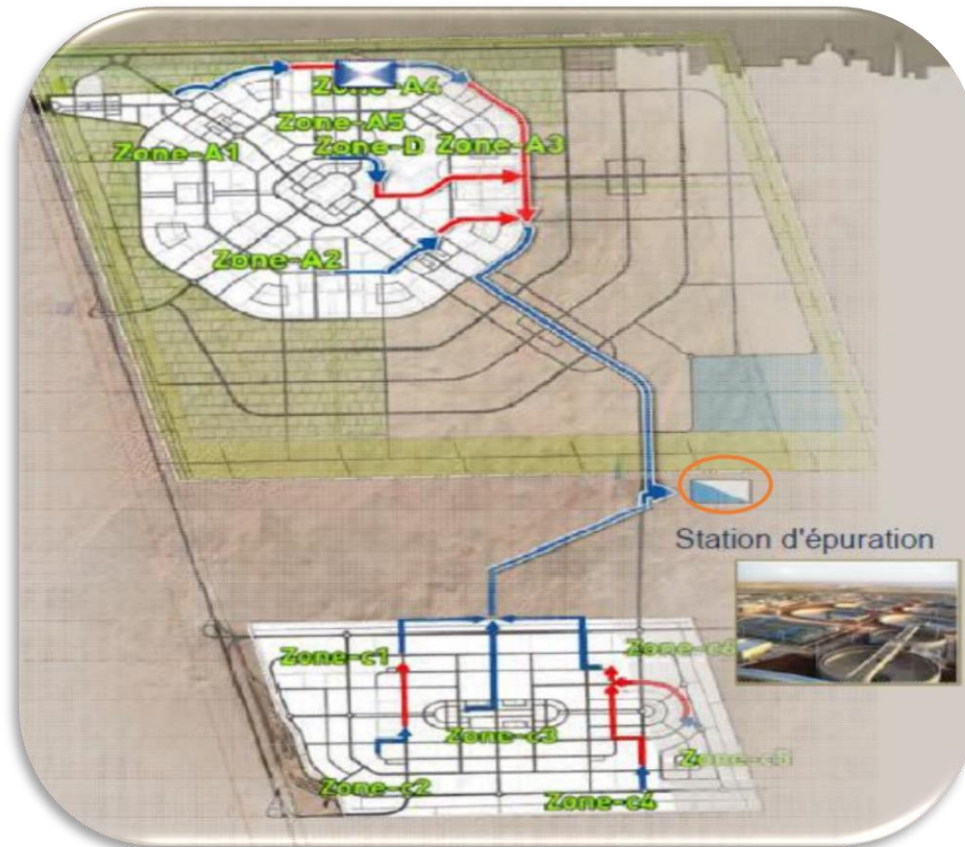
Figure 99 wastewater treatment and recycling system (GROUPEMENT DONGMYEONG , EVNH, 2012)

F. **Renewable energy and energy efficiency**: Renewable energy and energy efficiency are important aspects of the new city of Hassi Messaoud. The project aims to be a model for advanced solutions in the field of renewable energy, particularly solar energy, in order to achieve the government's 2030 renewable energy and energy efficiency goals. One of the ways the project is promoting energy efficiency is through the development of energy-efficient housing. This includes designing buildings that are well-insulated and using materials that reduce energy consumption. Solar energy is being used for air conditioning in the new city, as it is an abundant and clean source of energy in the region. Additionally, energy performance measures are being implemented in street lighting, which will help to reduce energy consumption and costs. The agriculture sector is also being included in the energy control

measures. The project is exploring ways to optimize energy consumption in agriculture, such as through the use of solar-powered irrigation systems. Overall, the project is prioritizing the use of renewable energy sources and energy-efficient measures to minimize environmental impacts and reduce the city's carbon footprint. (GROUPEMENT DONGMYEONG , EVNH, 2012)

3. SWOT analysis of the strategy of the new town Hassi Messaoud

Table 9 SWOT analysis of the strategy of the new town Hassi Messaoud

Strengths:	- The city has a strategic location, nestled between three major cities and home to internationally acclaimed oil and gas companies like SONELGAZ. This advantageous position is a great strength that can stimulate investment and propel the city's economy forward. - The city prioritizes renewable energy and energy efficiency, which deserves applause since it aligns with what the government envisions. The commitment could potentially propel it to become an exemplar in this sphere. - Green space importance the development of parks and green spaces around the city is an important benefit that can enhance the quality of life, improve the environment, and reduce the consequences of the desert climate. - Creative urban planning the city's urban design is innovative, with characteristics such as a green strip, vegetative screens, and windbreaks that may help reduce the effects of the harsh desert climate.
Weaknesses:	- The city's economy heavily depends on the oil industry, which could represent a concern in the long run if the oil marketplace needs significant shifts or a move toward renewable energy resources. - Scarcity of water resources Because of being in a desert climate, the city has limited water supplies, which might make designing and maintaining green spaces and farming difficult. - Applying the city's unique urban design and renewable energy plans demands a large initial investment, which might prove an expense. - The harsh desert climate contains sand wind, high sunlight, a long-term hot spell, a huge daily range in temperature, and very little rainfall.
Opportunities:	- The increasing need for renewable energy sources provides a chance for the city to present itself as an example in these areas and encourage investment. - Diversify the economy by investing in renewable energy and supporting other sectors including tourism and the agricultural sector, the city has a chance to expand its economy outside the oil industry. - The city's development can also help the growth of the area and encourage investments in cities nearby. - The city's traffic location for road connections and other road infrastructure projects offers a chance for developed accessibility and economic activity.
Threats:	- Administrative stability in the area may have an effect on the city, posing a problem to the application of the city's goals and investment. - The effects of climate change could damage the city's sustainability and ability of its renewable energy and water management actions. - Economic difficulties or changes in the oil industry might damage the city's economy and ability for getting investment. - The city's urban structure's irregularity and imbalances might damage its accessibility and value to residents and investment.

source: From the preparation of the student based on the references mentioned before

Conclusion

The new town of Hassi Messaoud has been designed to be a sustainable city, prioritizing environmental considerations and promoting a high quality of life for its residents. However, it should be noted that while it is a sustainable city, it does not possess the characteristics of a smart city.

The focus on sustainability in the new town of Hassi Messaoud is evident through various aspects of its design and infrastructure. The city has implemented environmentally friendly practices, such as efficient water supply and wastewater management systems. These systems have been engineered to optimize water usage, minimize waste, and conserve valuable resources.

Additionally, sustainable construction techniques and materials have been employed, ensuring energy efficiency and reducing the environmental footprint of the buildings within the city. The integration of renewable energy sources, such as solar or wind power, further contributes to the sustainability goals of the new town.

Green spaces and recreational areas have been incorporated into urban planning, providing residents with access to nature and promoting a healthier lifestyle. These green spaces not only enhance the aesthetic appeal of the city but also contribute to the overall well-being of its inhabitants.

Despite these commendable sustainability efforts, it should be acknowledged that the new town of Hassi Messaoud is not categorized as a smart city. A smart city typically incorporates advanced technologies and data-driven systems to enhance efficiency, connectivity, and the overall urban experience. These technologies may include intelligent transportation systems, smart grids, digital infrastructure, and advanced data analytics.

While the new town of Hassi Messaoud may not possess these advanced technological features, it still stands as a testament to the importance of sustainable development and responsible urban planning. The city serves as a model for integrating environmental considerations and creating a livable and harmonious community.

The new town of Hassi Messaoud has been carefully designed to prioritize sustainability and provide a high quality of life for its residents. However, it should be noted that while it embodies sustainable practices, it does not fall under the category of a smart city in terms of advanced technologies and data-driven systems.

General Conclusion

General Conclusion

The new town of Hassi Messaoud is a strategic development project mandated by the Algerian government to address the risks and challenges posed by the existing city. The project aims to create a sustainable and dynamic urban environment that balances the use of fossil fuels and renewable energy sources. It seeks to improve regional infrastructure, enhance the quality of life for residents, and promote economic growth and job creation in various sectors.

Results achieved from the study:

The study conducted on the new town of Hassi Messaoud has provided valuable insights into its territorial and regional situation, the historical overview of the present city, the creation of the new city, its objectives, and its strategic vision. It has also analyzed the accessibility to the new town, the role of doors in integration, and the geographical context, including climate factors such as wind patterns, temperature, humidity, and precipitation.

Is the new town a smart city or just a sustainable city:

Based on the study, it can be inferred that the new town of Hassi Messaoud is primarily focused on being a sustainable city. It aims to achieve economic, social, and environmental sustainability by implementing efficient infrastructure networks, promoting renewable energy sources, meeting residents' needs, reducing environmental impact, and enhancing the quality of life. While the city incorporates modern elements and technologies, the emphasis seems to be on creating a balanced and sustainable community rather than being a fully integrated smart city.

Factors that make the new town sustainable:

Several factors contribute to the sustainability of the new town of Hassi Messaoud. These include the incorporation of renewable energy sources, efficient infrastructure networks, waste recycling and treatment, reduction of greenhouse gas emissions, promotion of energy savings, sustainable housing, and adaptation to the Saharan climate. The focus on economic growth, social well-being, and environmental stewardship also contributes to its sustainability.

Recommendations to make the new town a smarter city:

To further enhance the development of the new town of Hassi Messaoud into a smarter city, the following recommendations can be considered:

> 1. Embrace advanced technologies: Incorporate innovative technologies such as Internet of Things (IoT), smart grids, and data analytics to optimize resource management, improve energy efficiency, and enhance overall city operations.

> 2. Develop a robust digital infrastructure: Establish a reliable and high-speed communication network to support smart city applications, data exchange, and connectivity among various sectors and stakeholders.

> 3. Implement smart mobility solutions: Introduce intelligent transportation systems, including smart traffic management, electric vehicles, and integrated public transportation systems to enhance mobility and reduce carbon emissions.

4. Foster citizen engagement: Encourage active citizen participation through digital platforms, smart city apps, and online services that facilitate communication, collaboration, and feedback between the government, residents, and businesses.

5. Promote data-driven decision-making: Utilize data analytics and real-time monitoring to gather insights and make informed decisions for urban planning, resource allocation, and service delivery.

6. Ensure cybersecurity: Implement robust cybersecurity measures to safeguard sensitive data, protect critical infrastructure, and maintain the privacy and trust of residents and businesses.

7. Foster innovation and entrepreneurship: Support the growth of local startups and innovation hubs that focus on smart city technologies, attracting investment, and creating job opportunities in the digital economy.

8. Embrace Heat Mitigation Strategies: Implement heat-reflective materials, shading devices, and passive cooling strategies in buildings and public spaces to mitigate the impact of high temperatures.

9. Embrace Renewable Energy: Expand the use of renewable energy sources like solar panels and wind turbines to reduce reliance on fossil fuels and promote a sustainable energy mix.

10. Improve Smart Waste Management: Implement smart waste bins, waste management software, and recycling initiatives to optimize waste collection and promote sustainable waste management practices.

11. Improve Smart Water Management: Utilize smart irrigation systems,

By incorporating these recommendations, the new town of Hassi Messaoud can move towards becoming a smart city, leveraging technology and data to enhance its sustainability, efficiency, and quality of life for its residents.

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Appendix

Interview Question

Questions sur les aspects techniques et les caractéristiques de la ville nouvelle de Hassi Messaoud

1 _ Quelles sont les références pour les conceptions de logements à travers le caractère architectural qui reflète l'identité de l'homme sahraoui et son patrimoine culturel ?

2 _ Quelles mesures ont été prises pour intégrer les technologies durables dans la construction et l'exploitation des bâtiments et des infrastructures de la nouvelle ville ?

3 _ Quelle est la nature des initiatives mises en œuvre pour promouvoir l'utilisation de l'énergie et réduire l'impact environnemental de la nouvelle ville ?

4_ Y-a-t-il une intention d'utiliser des sources d'énergie renouvelable comme l'énergie solaire ou éolienne pour répondre aux nouveaux besoins énergétiques de la ville ?

5- Quêtent la participation de la communauté et les intervenants influencé la prise de décisions techniques et politiques sur les options de site et les conceptions techniques de la nouvelle ville ?

Questions sur les caractéristiques sociales territorial de la ville nouvelle de Hassi Messaoud

6 _ Quelle est la composition et le composant démographique de la nouvelle ville : sa source est-il la migration interne ou le déplacement industriel ?

7 _ Comment sera régulé le mouvement entre l'ancien tissu (lieu de travail industriel de l'emprunteur) et (la nouvelle ville résidence sociale confirmé) la distance entre les deux environnements est estimée presque 80 km ?

8 _ Y-a-t-il des processus d'urbanisme et de programmation qui cadrent avec l'expansion et la croissance démographique au futur ?

9 _ Quel type de relation développé pour assurer l'équilibre interne de la nouvelle Ville en mettant l'accent sur les villes voisines Ouargla Touggourt Hassi Messaoud (zone industrielle) et vice versa ?