Environmental Investment in low-carbon Urban Mobility: Case study New Administrative Capital, Egypt

Pro. Lamis Saad ElGizawi
Professor of Architecture, Architectural Engineering Department, Faculty of Engineering, Mansoura University
lamiselgizawi@yahoo.com
Dr. Asmaa Nasr Eldin elbadrawy
Lecturer, Architectural Engineering Department, Faculty of Engineering, Mansoura University
asmaaelbadrawy@gmail.com
assist. Lect. Marwa Adel soliman Shehata
Teaching Assistant, Architectural Engineering Department, Faculty of Engineering, Mansoura University.
marwa_elfiky@mans.edu.eg

abstract:

Environmental investment in low-carbon urban mobility contributes to the promotion of strategic goals to reduce global climate change, achieve global environmental quality, and preserve the public health of societies. In order to achieve this concept, an integrated relationship must be achieved between planning, environmental technology, information technology, and support, and the legislation that supports future plans for urbanization. The research also aims to formulate a methodology to activate the role of environmental investment in low-carbon urban mobility in future cities as a tool to reduce climate change. The research problem represented in the gap between the goals of low-carbon urban mobility and the current mobility schemes has been studied in urbanization, one of the main causes of global warming and the global climate crisis that the global reality suffers from. Through the theoretical, analytical approach represented by literature reviews for each of the concepts of environmental investment, the concept of low-carbon urban mobility and its objectives, and general principles for achieving the concept of low-carbon urban mobility in future cities. Then the analytical study of the leading urban practices of low-carbon mobility (Paris, France, Copenhagen, Denmark, Songdo, Japan) from the visions and strategies that were implemented in those practices, and extracting the most important criteria and indicators through which environmental investment in low-carbon urban mobility can be evaluated in city plans. Then a case study in the new administrative capital in Egypt, as one of the models of the new urban trends in Egypt. By establishing new cities concerned with preserving the environment, reducing carbon emissions in urbanization, and achieving the vision of Egypt 2030, then evaluating the case study for the extent to which environmental investment standards and indicators have been achieved in urban mobility. Then followed by the results and recommendations represented in the methodology used to achieve environmental investment in existing and future urbanization, then search for recommendations.

keywords:
Environmental investment, low carbon mobility, mobility innovations, clean technology.

الملخص:
يساهم الإستثمار البيئي في التنقل الحضري منخفض الكربون في تعزيز الأهداف الاستراتيجية للحد من تغير المناخ العالمي وتحقيق جودة البيئية العالمية والحفاظ على الصحة العامة للمجتمعات، ومن أجل تحقيق هذا المفهوم، لابد من تحقيق علاقة تكاملية بين كل من التخطيط، والتكنولوجيا البيئية، وتكنولوجيا المعلومات، والدعم، والتشريعات الداعة في المخططات المستقبلية للعمران. كما يهدف البحث إلى صياغة منهجية لتفعيل دور الإستثمار البيئي في التنقل الحضري منخفض الكربون في مدن المستقبل كأداة للحد من تغير المناخ. وقد تم دراسة المشكلة البحثية المتمثلة فى
الفجوه بين أهداف التنقل الحضرى منخفض الكربون وبين مخططات التنقل الحالى بالعمران أحد أهم المسببات الرئسية للاحتباس الحراري وازمة المناخ العالمية التى يعاني منها الواقع العالمى. وذلك باتباع المنهج التحليلي النظري المتمثل في مراجعات الأدبيات لكل من مفهوم الاستثمار البيئى، ومفهوم التنقل الحضري منخفض الكربون واهدافة، والمبادئ العامة لتحقيق مفهوم التنقل الحضرى منخفض الكربون في مدن المستقبل. ثم الدراسة التحليلية للممارسات العمرانية الريادية للتنقل منخفض الكربون (باريس ، فرنسا ، كوبنهاغن ، الدنمارك ، سونجدو ، اليابان) من رؤي واستراتيجيات تم تنفيذها فى تلك الممارسات .واستخلاص لاهم المعايير والمؤشرات التي يمكن من خلالها تقييم الاستثمار البيئي في التنقل الحضري منخفض الكربون في مخططات المدن الجديدة ، ثم دراسة حالة متمثلة فى العاصمة الإدارية الجديدة في مصر، كأحد نماذج اتجاهات العمران الجديد في مصر.بانشاء مدن جديدة تهتم بالحفاظ على البيئة والحد من انبعاثات الكربون فى العمران وتحقق روية مصر ٢٠٣٠ ثم تقييم دراسة الحالة لمدى تحقيق معايير ومؤشرات الاستثمار البيئي فى التنقل الحضرى . ثم تلي ذلك النتائج والتوصيات متمثلة فى المنهجية المتبعة لتحقيق الاستثمار البيئى فى العمران القائم والمستقبلى. ثم توصيات البحث.

الكلمات المفتاحية:
الاستثمار البيئي، التنقل منخفض الكربون، ابتكارات التنقل، التكنولوجيا النظيفة.

1. introduction

Recently, the global reality has suffered from the phenomenon of global warming. As a result of greenhouse gas emissions resulting from vehicles used in mobility and various industries, urban mobility is one of the largest sectors contributing to greenhouse gas emissions by 23% worldwide. (Qamar, et al. 2020, IEA 2013) As cities grow in size and populations get more mobile from using vehicles in our cities (Singh, et al. 2022), the International Energy Agency expects carbon emissions from urban mobility to increase by 70% by 2050. Despite many technological improvements to mobility, this results in many negative effects on the ecosystem, public health, the environment, and the economy, (Singh, et al. 2022). Environmental investment in low-carbon urban mobility has become an urgent necessity in order to reduce the environmental, social, and economic impacts of current and future urbanism. (Wimbadi, Riyanti and Akihisa 2021) Therefore, the research is concerned about the role of environmental investment in low-carbon urban mobility to reduce global warming.

Therefore, the thinking of dealing with urban mobility systems must change the protection of the environment and its resources is an urgent necessity, and increase the efficiency of energy use and increase the contribution of clean energies to reduce the adverse effects on the environment and direct all environmental investments to the mobility sector in the current and future construction. Therefore, the research is interested in studying the role of environmental investment in mobility to reduce the phenomenon of global warming in Urban areas. And that is by testing the research hypothesis of the integrative relationship between planning and

applications of information technology and environmental technology and between support and legislation to achieve the concept of environmental investment in low-carbon urban mobility.

1.1 Aim of the research:

The research also aims to formulate a methodology to activate the role of environmental investment in low-carbon urban mobility in future cities as a tool to reduce climate change.

1.2 Methodology

The research follows a methodology through the theoretical, analytical approach represented by literature reviews and the case study as follows:

- Theoretical approach: Literature reviews for each of the concepts of environmental investment, the concept of low-carbon urban mobility and its objectives, and general principles for achieving the concept of low-carbon urban mobility in future cities.
- Analytical approach: Analysing global projects of the leading urban practices of low-carbon mobility (Paris, France, Copenhagen, Denmark, Song do, Japan) from the visions and strategies that were implemented in those practices. And extracting the most important criteria and indicators through which environmental investment in low-carbon urban mobility can be evaluated in city plans.
- Case study approach: An applied study of the new administrative capital in Egypt as one of the models of the new urban trends in Egypt. Through an analytical study City master plan, the design and the planning of urban mobility and the infrastructure on which the city relied, then evaluating the case study for the extent to which environmental investment standards and indicators have been achieved in urban mobility. Then followed by the results and recommendations of the methodology used.

2. the thereoretical study: an introduction to the concept of environmental investment in low-carbon urban mobility

2.1 Environmental investment:

It is the investment that depends on the optimal use of resources and the reduction of environmental stress. It is concerned with environmental and social standards and corporate governance. It is based on certain moral or ethical values to generate long-term financial returns, and have a positive impact on the environment, society, and economy at the same time. (Khaddour 2008)

2.2 Investing in Low Carbon Urban Mobility

The urban mobility sector attracts great attention worldwide, as it promotes economic development and the well-being of society. Despite this, it produces many negative effects on public health and the environment, the most important of which are harmful emissions, which are directly responsible for the phenomenon of global warming and climate change that the world is suffering from at the time (Kinigadnera, et al. 2020) .Recently, environmental investment in low-carbon mobility has received support from international agencies and organizations, because it contributes to reducing the climate change phenomenon, enhancing competitiveness in the economy, providing a large number of jobs, global quality of life, achieving well-being for society, and achieving energy efficiency and environmental sustainability.

2.3 principles of low-carbon urban mobility

In order to realize the concept of low carbon urban mobility, it is necessary to achieve an integrative relationship between planning and preparing the urban environment for the main roads in the city and between investments in environmental technology that support the preservation of the environment and its resources and between information technology applications and between support, convenience and legislation.

2.3.1 physical urban environmental:

Through the integration of environmental planning, energy efficiency, and mobility services as follows: (S´anchez and Govindarajulu 2023) (Minh 2016) (Infunti and Ioanna 2020)

- Integration of urban transport facilities.
- Multi-use planning for neighborhoods and Urban planning less dependent on the car.

Figure **1**

- Designing a movement system does not depend on increasing street widths to accommodate the largest number of cars but on the efficiency of use and dependence on alternative means. (bicycles& public transportation.)

Figure 2

- The efficiency of the use of mass transportation and reliance on alternative means.
- Incorporation of plant elements in all paths and roads.
- Integrating renewable energies in the design of the main paths of movement.
- The cross-sectional design of roads and services supports clean technology.

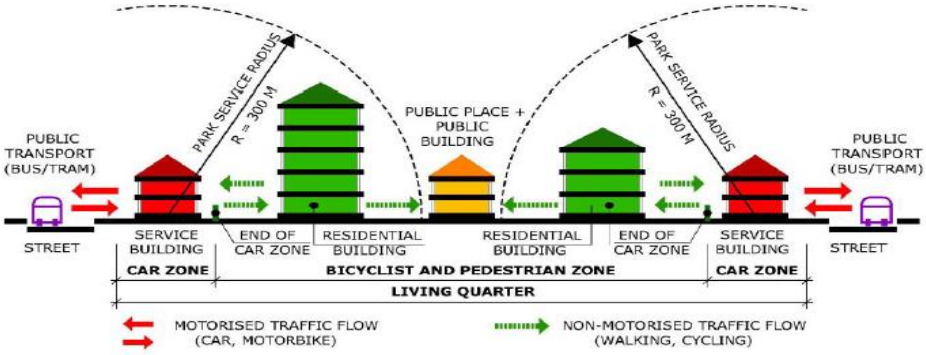


Figure 1: Section of car- free living in Hanoi Source: (Minh 2016)

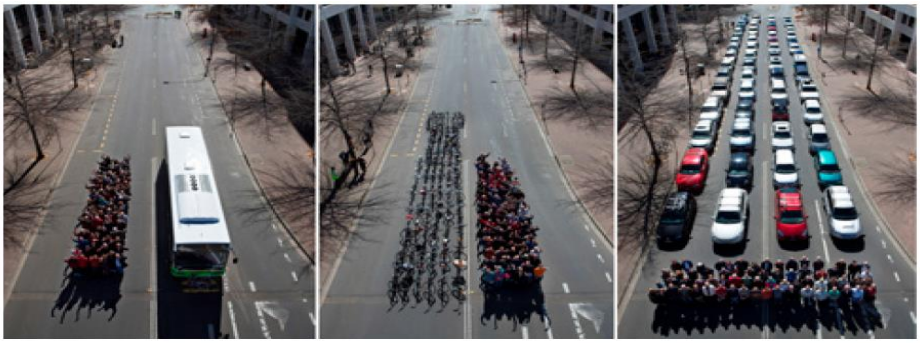


Figure 2: The spaces that 69 people need to transport by public Source: (Transport. 2019)

2.3.2 Integration of infrastructure and information technology:

By achieving the following points: (Infunti and Ioanna 2020) (Transport. 2019)

- Providing services based on information technology.

- The use of different technical solutions in the various fields of transport and traffic sciences.
- Providing applications to share data for parking lots and services.
- Support smart applications to facilitate traffic.
- Providing all data and information about the city's mobility system.
- Ease of use and access to data that serves users.

Figure 3: Connecting services to technological infrastructure to reduce traffic congestion
Source: (Infunti and Ioanna 2020)

2.3.3 Support and application of clean technology:

By achieving the following points: (Infunti and Ioanna 2020) (Transport. 2019)

- Financial support for clean technology programs.
- Work on preparing a fund to invest in mobility.
- Providing programs that support bicycles that depend on freight.
- Supporting the auto industry, clean technologies, and adaptation.
- Continuing to fund scientific research and development of low-carbon technologies.
- Reorganizing the mechanisms of investment in low-carbon transportation facilities.
- Reliance on zero-emissions vehicles and self-driving vehicles.

2.3.4 Community participation and appropriateness

- Improving the general condition of public transport.
- Providing all services and facilities to convince users to rely on public transportation.
- Easy access to the main stations and the ability to bear costs.
- Providing the basic needs of comfort and health for all classes.
- Caring for people with special needs.
- Encouraging community participation and raising awareness of the importance of mass transportation or joint transportation.
- Supporting education for the principles of preserving the environment and health.

2.3.5 Legislations

- Mandatory integration of mobility management into national or regional legislation.
- Develop legislation for planning regulations, public attitudes, and environmental legislation (Minh 2016).

3. the analytical study:

3.1 leading practices in low-carbon mobility

Copenhagen- Denmark, Paris- France, and Songdo- Japan were selected as the urban practices that support the environmental investment in mobility is based on several criteria, which is to include one of the theoretical bases for investment in mobility as shown in Table 1, and to be a

contribution to limiting global climate change, as an attempt to reach the most important principles and pillars on which those practices relied upon.

3.1.1 Copenhagen- Denmark

Copenhagen is the capital of Denmark, located in northern Europe, with a population of about one million people. Focusing on policies that support pedestrians (Fayed, Elshate and Rashed. 2019) and mass transportation, starting with the proposed plan.

3.1.1.1 Vision and goals of Copenhagen

Reaching the best cycling city in the world is part of Copenhagen's vision to become an eco-friendly capital and one of the general goals of becoming a carbon-neutral city by 2025, and enhance the city's liveability (Gunn 2018).

3.1.1.2 Urban practices for low – carbon urban mobility in Copenhagen

Aspects of achieving low-carbon urban mobility in Copenhagen are represented in the following points: (Fayed, Elshate and Rashed. 2019), (Gunn 2018). (Days 2018) (TMF 2017) (Samuels and Altinay Karasapan 2014)

- Relying on the mass transportation system, starting with the city's finger scheme.
- Promoting integrated development and multiple uses of land.
- Integration between means of transportation and complementarity among them.
- The cross-section design of the roads supports walkability and cycling.
- Banning the movement of cars inside the historic city centre.
- Providing financial and administrative support for mobility plans from 2004 to supporting cycling strategies in 2011.
- Allocating 80 € million to cycling strategies.
- Preparing the infrastructure for supportive planning for bicycles by providing parking spaces and anchored communication elements for cycling transport. Designing spaces and paths to support cycling.
- The construction of many bridges including bridges for bicycles and pedestrians from 1886 to the present time.
- The flexibility of public transportation to move within it by bicycle.
- Improving traffic lights to suit the traffic flow of grades.
- Smart mobility and sharing of electric cars and bikes.
- Applying the green wave technology to the stair lanes to control the traffic flow during peak hours.
- Preparing a proposal for PLUS NET bike paths, which will be completed in 2025.
- Many occupations and cultures accept cycling. The ratio of bicycle ownership to cars is 5:1.

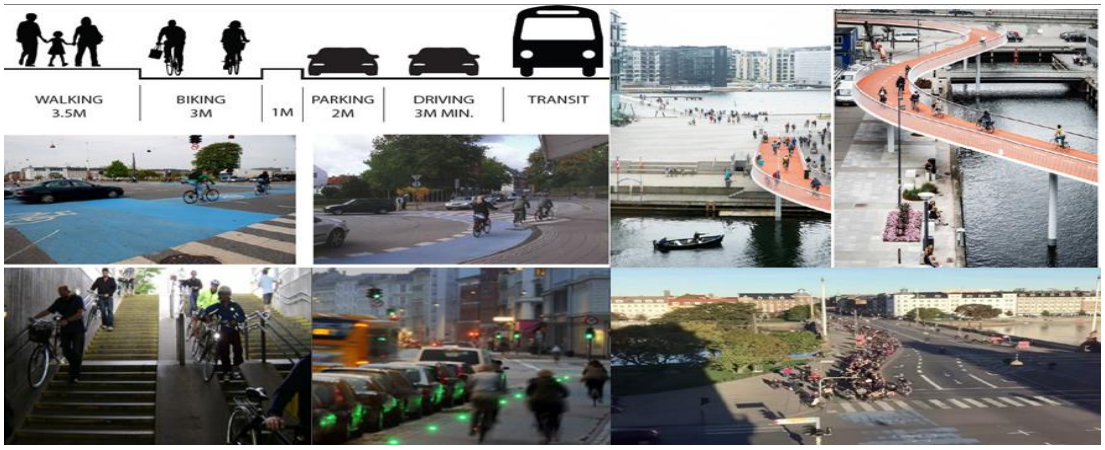


Figure 4 : Prepare the urban environment to low carbon urban mobility in Copenhagen Source: (TMF 2017), (Fayed, Elshate and Rashed. 2019), (Gunn 2018)

3.1.2. Paris – France

It is the capital of France and its largest city in terms of area. It is located on the banks of the Seine River in the north of the country. Its suburban population reaches 12 million people. It is also famous for its museums and architectural tourist attractions. It is also famous for its mass transit system, beginning of the metro line in 1900. (Wikipedia 2022)

3.1.2.1. Vision and goals of Paris

Mobility behaviour has shifted toward more sustainable modes of public transport. The 2016 national strategic objectives for sustainable mobility development included the following: A 40% decrease in greenhouse gas emissions by 2030, 30% less consumption of fossil fuels relative to 2012, and an increase in the share of renewable energies by 23%. (Infunti and Ioanna 2020)

3.1.2.2 Urban practices for low – carbon urban mobility in Paris

Aspects of achieving low-carbon urban mobility in Paris are represented in the following points (Europe 2015), (Najdovski 2017), (Knupfer, Pokotilo and Woetzel 2018) (Mirabella, Kehagia and Psomopoulos 2019):

- Public investment in public transportation and the allocation of Grand Paris taxes for the establishment of new metro lines and the expansion of new lines powered by electric power.
- Working to connect the suburbs with the main traffic hubs of the city.
- Reliance on sharing electric cars from several applications, including (Autolib).
- Providing places and services for participating cars at the city level.
- Continuous work on developing public transportation and creating the urban environment for transportation.
- Financial financing to support electric cars from the public and private sectors in Paris.
- The cost of the service for the participating cars is suitable for different segments.
- Many jobs and cultures are accepting of abandoning car ownership and relying on car-poolers.
- Integrating the green elements into all the main traffic paths for cars, public transport, and pedestrians.
- Integrating photovoltaic panels in main roads at a distance of (1 km) to be sufficient for street lighting.

- Transforming the city to accommodate the movement of pedestrians and bicycles, increasing the financial support for the bicycle path at the city level, and applying many technologies, applications, and services to support it.
- Provides many plans to raise awareness and support cycling at the city level.
- A large number of neighbourhoods and streets became empty of cars.
- Focusing on environmentally friendly services.
- A large number of public transportation has turned into environmentally friendly means, and by 2025 it will reach 100%.
- France adopted a law in 2019 that focuses on the goals of sustainable mobility, innovation in transportation, and the mitigation of climate change. It included facilitating business trips for companies with more than 50 employees through scheduling and remuneration for bicycle trips as a flat allowance or a 50% discount on nationwide public transportation for low-income people.

FIGURE 5- INCORPORATE GREEN ELEMENTS INTO PATHS AND OPEN SPACES IN PARIS .
source: (Gunn 2018)& (Najdovski 2017)

3.1.3. Songdo- Japan

Songdo City is part of the Incheon Economic Zone and is located in the west of Incheon City (Lee, et al. 2016). It is a joint venture in June 2006, to renovate the international business district into a ubiquitous city (Rehan 2012) .It is the first city in Korea to be awarded the Leadership in Energy and Environmental Design (LEED) accreditation. While adhering to the most stringent environmental standards for energy and waste consumption. (Kolotouchkina and Seisdedos 2018)

3.1.3.1 Vision and goals of Songdo

Mobility behaviour has shifted towards more sustainable modes of public transport. The 2016 national strategic objectives for sustainable mobility development included the following: A 40% decrease in greenhouse gas emissions by 2030, 30% less consumption of fossil fuels relative to 2012, and an increase in the share of renewable energies by 23%. (Mohammadian and Rezaie 2020) (Patel and Padhya 2021)

3.1.3.2 practices for low – carbon urban mobility in Songdo

Aspects of achieving environmental investment in mobility in Songdo are represented in the following points (Lee, et al. 2016) -(Ekman 2015) :

- The city is designed to comply with LEED standards.
- Pedestrian and bicycle paths and green spaces represent 40% of the city's total area.

- The possibility of accessing all services in a period not exceeding 12.5 minutes due to the multiplicity of use and integration of the scheme.
- The cross-section is designed to support walkability.
- Separating the movement of pedestrians and bicycles to achieve safety and security for users.
- Providing parking spaces for bicycles.
- The possibility of sharing free bikes for a period not exceeding 3 hours.
- Integration of public transportation to the general plan of the city.
- Relying on clean energy for the city's public transportation.
- Adopting (U IT) technology in traffic management and monitoring, and providing all public services for transportation.
- Providing surveillance cameras to achieve security and safety.
- Directing the violating waiter to the nearest waiting places.
- Control of traffic lights according to rush hour and emergency.
- Providing sound sensors linked to the main service departments.
- Monitoring vehicles that are late in collecting taxes or required by the police and all competent authorities are contacted to speed up the response.
- Sensors to know the air quality and weather conditions in the city.

Figure 6-. (a) Incorporate green elements into paths and open spaces.
(b) Connecting bike paths. (c)Electronic city monitoring and smart parking.
Source: (Lee, et al. 2016) (KPF 2023)

- By studying the principles of low-carbon urban mobility and pioneering urban practices in environmental investment in urban mobility. For Copenhagen, recipient of the (European Green Capital Award) (Fayed, Elshate and Rashed. 2019) , and the city of Songdo, recipient of the Leadership in Energy and Environmental Design (LEED) accreditation (Kolotouchkina and Seisdedos 2018) , and the environmental practices of France to reduce global warming. A number of criteria and indicators have been extracted through which it is possible to evaluate the environmental investment in low- carbon urban mobility in the future construction.

➢ **Table 1.**

table 1: criteria and indicators for evaluating the environmental investment in mobility.			
Evaluation Criteria		**Indicators**	
physical urban environmental	**Urban planning and design**	**A1**	multi-use neighborhood planning supports walkability.
		A2	the neighborhood layout is suitable for all users.
		A3	a flexible layout provides multiple options for public transportation.
		A4	supportive planning for the connection of pedestrian and bicycle paths.
		A5	urban design for car-free areas.
		A6	multiple nuclei of service centers and waiting for friendly means of transportation (bicycles, electric cars).
		A7	efficient rain drainage infrastructure at the city level.
	Security and safety for users	**A8**	surveillance cameras 24 hours a day for the streets and main stations of public transport.
		A9	sensors distinguish natural and unnatural sounds for human gatherings.
		A10	determining the speed within the regions and electronic control.
		A11	applications to track student mobility by bicycle.
		A12	separating walker traffic from bicycles and cars, it gets easier for people with special needs to move.
		A13	availability of guiding signs and appropriate lighting for the use of the paths.
Integration infrastructure and information technology	**Access & Connectivity**	**B1**	connecting all areas with wired and wireless networks.
		B2	applications for car and bike-sharing and parking.
		B3	electronic control of traffic lights at peak times.
		B4	providing electronic services within the city to reduce time and energy.
		B5	applications on the status of traffic flow linked to mobile phones.
		B6	traffic flow control for cars and bikes.
		B7	supporting public transportation to move with bikes.

Source: The Authors

Table 1: Criteria and indicators for evaluating the environmental investment in mobility.			
Evaluation Criteria		**Indicators**	
	Comfort	**B8**	Supportive electronic services to facilitate attracting investments.
		B9	Applications to support basic information for transport trips and the ability to book online.

		B10	Integration of public transportation: Railways - metro - public buses.
		B11	Availability of parking spaces for bicycles in the main stations in the city.
		B12	Mobile service centers for bicycles and cars in addition to central service centers.
		B13	Ease of regional access to the city and the main mobility centers and its data.
		B14	Achieve thermal, acoustic and visual comfort.
Support and application of clean technology	**Preserving the environment**	**C1**	Low-emission and environmentally-friendly vehicles.
		C2	Sensors to measure air quality and gas emissions and plans to deal with them.
		C3	Integrating renewable energies into the urban design of the main roads.
		C4	Integrating green spaces into cross-sections of all paths and roads.
	Financial support	**C5**	Determining the sources of financing for the infrastructure of the transport system.
		C6	The cost of public transportation services shared cars, and bicycles are suitable .
		C7	Reducing licensing fees for environmentally friendly cars.
		C8	Allocate finances to support the services and follow up the efficiency of the physical environment and public transportation.
		C9	Funding scientific research and development of low-carbon technologies.
d- community participation and appropriateness	**environmental awareness**	**D1**	Participation community to make design decisions and meet their needs.
		D2	Environmental awareness and education for all age groups.
		D3	Cycling culture is accepted by all.
	Efficiency & quality	**D4**	Quality and efficiency of public transport.
		D5	Flexibility and convenience of public transportation to move with bikes.
		D6	Maintenance and follow-up to achieve the efficiency of the physical environment and public transportation.
F - Legislations	**Administrators**	**F1**	Administrative control over 24 hours for all paths and roads in the city.
		F2	Facilitate environmental investment procedures in the transportation system.
		F3	Legislative decisions to establish cities with environmental specifications.

	Citizens	**F4**	Support for university students to use bicycles for transportation.
		F5	Increasing fines for Illegal parking for cars.

Source: The Authors

4. case study: the new administrative capital in egypt

It is a large-scale project that was announced at the Conference on Supporting and Developing the Egyptian Economy based on Presidential Resolution No. 57 of 2016. (almasryalyoum 2020) Within the framework of the state's vision for the year 2030, environmental commitment and reducing greenhouse gas emissions, the Administrative Capital Company for Urban Development participated in the activities of the COP27 Climate Summit held in Sharm El-Sheikh, with the aim of informing the world about it. The new administrative capital is a model for the largest projects in the Egyptian state that apply the elements of sustainability and development as the first smart city and an emphasis on activating the seventeen United Nations determinants of sustainability and development that are available in the administration (reda 2022). It is located 35 km from the centre of the old city and lies between the Greater Cairo Region and the Suez Canal Region, near the regional road and the Cairo-Suez Road.

Figure 3. The total area of project is 170,000 acres and was designed to accommodate 6.5 million people. (Metwally 2022)

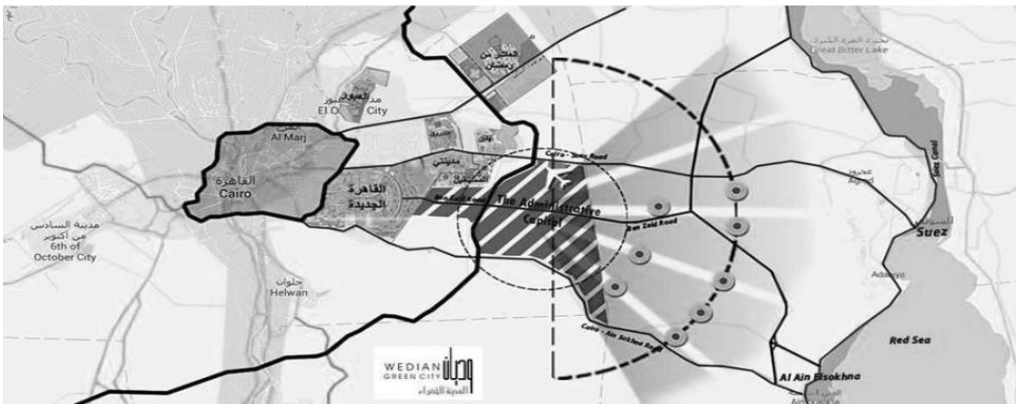


Figure 7: location of the administrative capital of the cities of Cairo and Suez
Source: (Serag 2017)

4.1 City master plan

A global city with a smart infrastructure is planned for the future of Egypt. Which will contribute to economic prosperity and the development of a distinguished quality of life. The general plan included 30% for residential areas, 25% for regional and commercial services, 15% for green and open spaces, and 20% for roads (Nasreldin and Abdelfattah Jan 2020). The master plan included three planning and development phases, the most important of which are the Green River, then the government district, which includes governmental and administrative activities, then the construction of residential phases in two successive phases, then the final phase of the project. (New Urban communities Authority 2022).

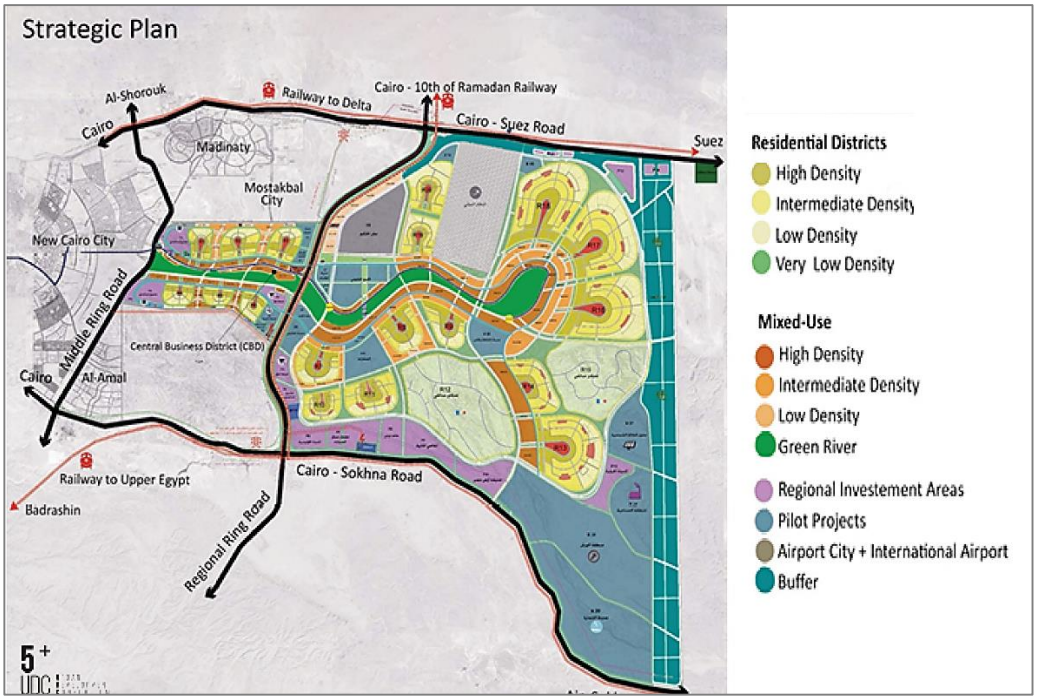
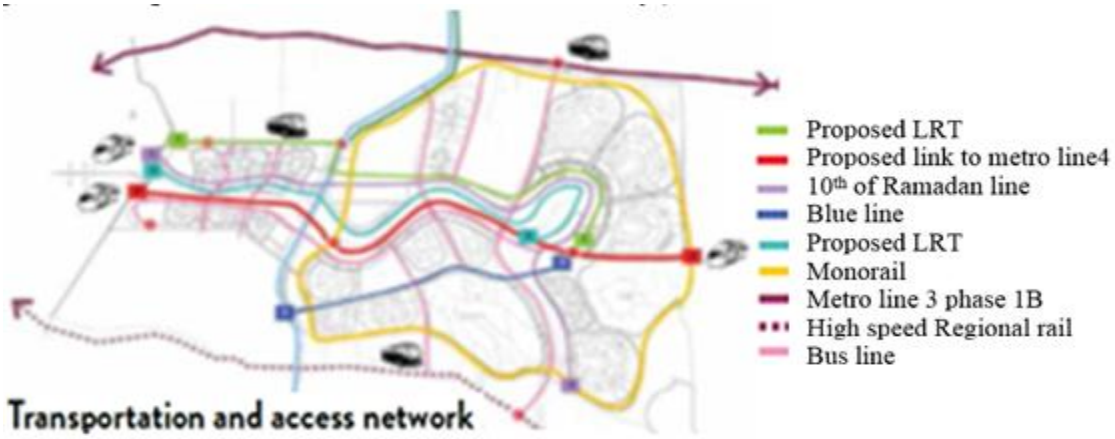


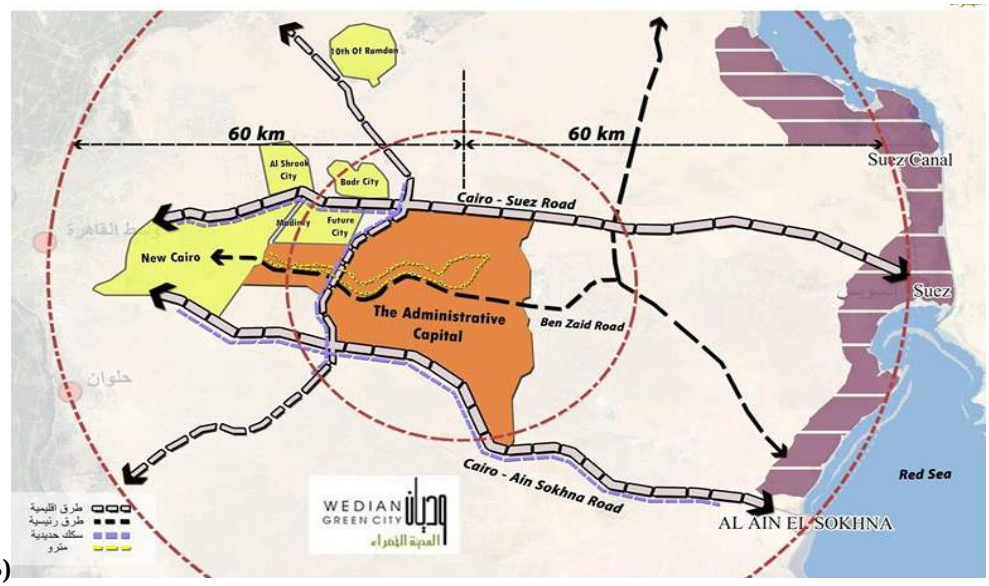
Figure 8: City master plan Source: (Metwally 2022)

4.2 Planning and designing the city's mobility

- The planning concept of the city is to be walkable, so the master plan of the city relied on the multi-use of the neighbourhood. Figure 8.
- In addition, 40% of paths for walkability and bicycles are designed to be connected and to provide all integrated public transportation and accessibility for all levels.



(A)



(B)

Figure 9.(A) The main axes of movement in the city .(B)Links between it and the surrounding cities. Source: (Capital homes 2017)

- Accessibility and linking the city to the regional traffic hubs and main roads, linking it to railways and metro, and the new electric monorail line to connect it to the city of Salam and the 10th of Ramadan. (Capital homes 2017).

Figure 10: Electric Monorail line project track. Source : (Metwally 2022)

- The integration of public transportation between buses with the proposed railways, as suggested by the main station plan of the new administrative capital, but it was noted that there is no parking for bicycles in it.
- Provide levels for walk paths within residential areas.
- The separation between pedestrians, cars, and bicycle paths was taken into account to achieve safety and security for users. As shown in one of the main traffic paths in the residential neighbourhood R3.
- Parking spaces were provided for cars, but no bicycle parking spaces were detected in the completed residential neighbourhood. Also, the bike paths were limited to only one lane at most of the paths, compared to the width of the roads designated for cars. Also, the paths of mass transportation and private cars were not specified in the road plan. No public services for cyclists.
- Through Figure 11. The integration of any type of renewable energy into the physical environment of the roads has not been observed.
- The green spaces have been integrated into all traffic paths for cars, pedestrian, and bicycles, in addition to the main artery of the Green River in the capital.

- An efficient rainwater drainage system was planned (New Urban communities Authority 2022).

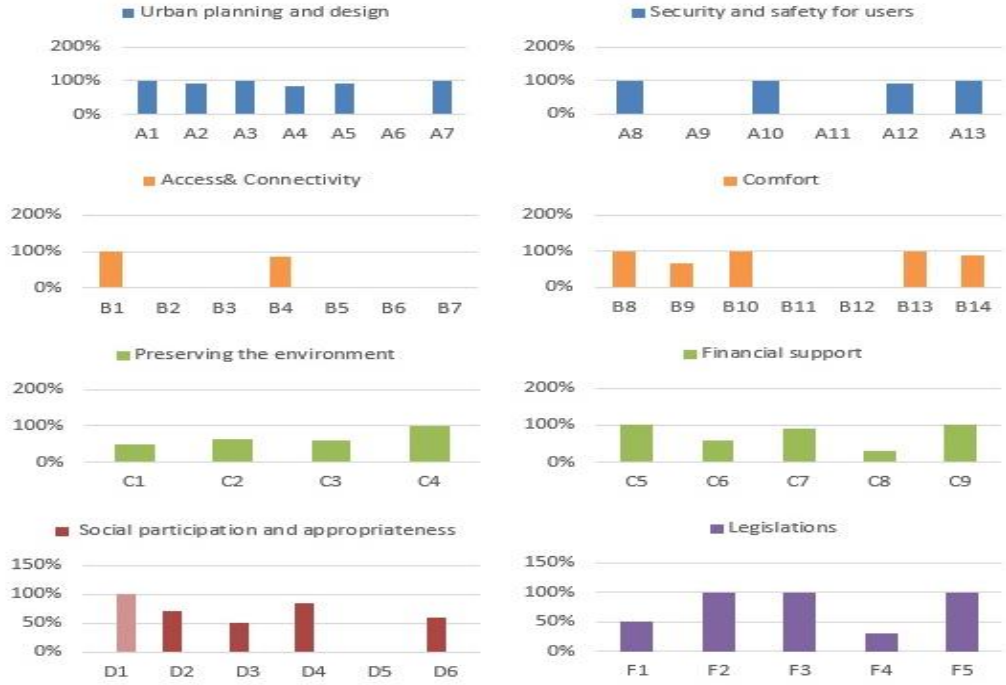
Figure 11. Designing bicycle and walking paths in the residential neighbourhood R3 in the new administrative capital.
Source: The Authors

4.3 Smart infrastructure for roads and information technology

- The city is designed on a unified digital infrastructure of fibre-optic cables to cover most of the city's area and links to internal networks to cover all the city's needs and all services. The city is designed with the latest technological technologies with international standards.
- The smart utility network, including water, electricity, and gas, has been placed inside tunnels for the possibility of accessing without harming the built environment of spaces and roads.
- Smart utilities also contribute to monitoring consumption. Smart sensors and sensors have been integrated into traffic, transportation, and smart road systems for the purpose of monitoring and general insurance for users in addition to controlling smart street lighting systems. (Elfatah 2018)

4.4 Indicators of environmental investment in low-carbon urban mobility in the new administrative capital.

Through what was studied in the case study of the administrative capital. The percentage of achieving environmental investment indicators in mobility will be studied. As in figure 12.



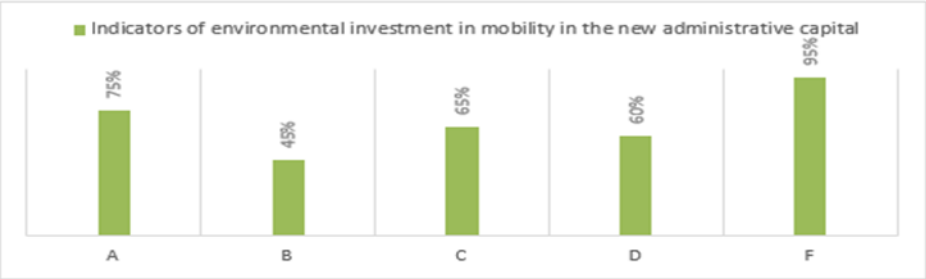


Figure 12. A graph showing the rates of environmental investment realization in the new administrative capital in Egypt.
Source: The Authors

5. discussion:

➢ By analysing the case study and evaluating it according to the indicators of environmental investment assessment in mobility. The new administrative capital in Egypt has achieved more than 70% of the environmental investment indicators in mobility as in figure 7. However, a shortcoming was observed in the percentages of achieving some of the previous indicators. In order to increase it, apply the following steps:

(a) At the level of urban planning and design:

- Incorporating bicycle parking design into all spaces and paths at the city level.
- Work to provide technical service centres for them as well.
- Designing vertical communication elements that support mobility for people of determination and special abilities, as well as cycling.
- Converting part of the private car parks into shared car parks at the city level.
- Increasing the applications of renewable energies in the details of urban design for all spaces and paths.
- Simulation application for the design of lanes and roads.

(b) At the level of applications of information technology and environmental technology:

- Designing tracking applications integrated into the sharing bikes.
- We are designing smart cards for individuals participating in participating cars and bicycles.
- Create a database for users of the participating means of transportation.
- Design applications to measure the satisfaction and quality of public transport and shared transport.
- Development of environmental technology contributes to raising the efficiency and quality of urban mobility.

(c) At the level of funding and legislation:

- Facilitating investment procedures in the transport sector.
- Tax cuts for investors in clean technology.
- Identification of specific sources for the maintenance and operation of roads, public transport and subscribers.
- Determining specific times for the movement of heavy transport and transporting waste at specific times at night.
- Support investment in the design and manufacture of public transportation that accommodates cycling for all members of society.

- Working on a public-private partnership to finance the sharing of bicycles and participating cars.
- Providing financial support for the bicycle project for university students.

(d) At the level of awareness and participation:

- Preparing training programs for children to be able to ride bicycles during the school day for school students.
- Preparing training and introductory courses for the possibility of using the sharing applications for bicycles and cars, and the possibility of tracking them.
- Set up incentives for college students for most participating bicycle users throughout the month.

6. results:

➢ The results represent a test of the research hypothesis and can be summarized as follows:

- Environmental investment in mobility is one of the tools that preserve resources, the environment, and the public health of the environment and society.
- To achieve the concept of environmental investment, an integrative relationship must be achieved between environmental planning, environmental technology, information technology, and legislation.
- By applying the concept of environmental investment in mobility in the current and future urbanism, zero carbon emissions and a reduction in global warming can be achieved.
- A number of Criteria and indicators for evaluating the environmental investment in mobility as (Table1) have been extracted through which it is possible to test the extent to which environmental investment has been achieved in mobility, represented in indicators of the impact of creating the urban environment, indicators of information technology integration with infrastructure, indicators of support and application of clean technology, community participation and appropriateness, and indicators of legislation.
- The Egyptian experience in establishing the new administrative capital in Egypt (a green and smart city) was able to change the institutional and legislative thinking and the management system of the state to support environmental applications and smart infrastructure and adhere to the new orientation of the state and achieve its environmental vision; new ideas, plans, and culture.

7. conclusion:

Through theoretical and analytical studies and case studies that were studied throughout the research period:

- Criteria and indicators for evaluating environmental investment in mobility were derived. (Table 1)
- Developing the executive steps to activate the role of environmental investment in low-carbon urban mobility in future urbanization. To reduce global climate change in future urbanization. (Table 2)

table 2 : the executive steps to achieve environmental investment in low-carbon urban mobility in the future urbanism	
Legislation	▪ **Mandatory legislation for administrative and regulatory authorities to achieve international strategic goals to reduce climate change and preserve the environment.** - Studying emerging international goals and appropriate new legislation. - The Urban Communities Authority, the Environmental Affairs Agency and the local councils. ▪ **Legislation is mandatory for citizens to preserve the environment with rights and duties for all activities.**
Planning & Aims	▪ **The institutional thinking in the state administration changed in line with the requirements of the times.** ▪ **Preparing theoretical and analytical thoughts for urban expansion locally and globally.** - Monitoring and analysing the urban reality of its pros and cons. - Document and analyse developments in environmental practices that support investment in and benefit from mobility. - Monitoring humanitarian requirements and needs. - Determine the sources of financing, maintenance and follow-up for the project. - Determining development goals and the extent to which they achieve the international strategic goals for preserving the environment and limiting climate change.
Awareness & community participation	▪ **Media awareness of the importance of environmental investment in mobility and its support in preserving the environment, public health and resources.** - Ministry of Education and the Ministry of Culture. - Ministry of Environment and Community Service. ▪ **Conducting training workshops for environmental applications.** ▪ **Inventory and periodic survey of the requirements of the local community and meet its needs**.
Preparing the planning idea for new urbanism& Mobility planning	▪ **Achieving the theoretical basics for environmental investment in urban mobility.** ▪ **Environmental simulation to design paths and roads to avoid and reduce collision points, through several simulation programs such as:** - UMI-for-(Rhino) & Pedestrian & Cup Carbon U-One &Urbanism& Sumo- Smart City Explorer &…etc. ▪ **Measuring indicators of environmental investment in low-carbon urban mobility.**

	▪ **Presenting plans to organizations supporting the preservation of the environment, benefiting from previous work, and providing financial support.** ▪ **Set up a clear and specific schedule.** ▪ **Making a virtual design of the city plans and presenting them to specialists from bodies, companies and the local community to express their opinions.**
Implementation stage	▪ **Committing to the schedule.** ▪ **Good follow-up to implementation of detailed plans for infrastructure and tracks by the project planners and implementers.**
After implementation	▪ Commitment to the standard of quality and efficiency by the owners of the project. - Forming an administrative structure dedicated to continuous follow-up and maintenance. - Allocating financial support from the Ministry of Transport and Roads. - Mandatory legislation for the administrative entity and users with the rights and duties related to the mobility system.

Source: The Authors

8. recommendations:

- The research recommends applying the proposed methodology to activate the role of low-carbon environmental investment in urban mobility in future urbanization and limiting climate change.
- Preparing a periodically updated and unified list of low-carbon environmental investment. Criteria and indicators as (Table 1) for evaluating the environmental investment in low-carbon urban mobility to be applicable to existing and new cities.
- The research also recommends completing the study of developments in environmental investment in urbanization in future research and academic studies.
- The research also recommends for the Department of Transport and Roads to set fines and penalties for violators of the instructions of morals and public behaviour in traffic.
- Supporting the possibility of exchanging dilapidated vehicles with low and subsidized clean energies. Expanding environmentally friendly mass transit projects at the city level as a tool to reduce the number of private cars.
- The research recommends the Ministry of Education to support and maintain students' environmental awareness through the curriculum.

9. references:

almasryalyoum. 2020. https://www.almasryalyoum.com/news/details/889790. 8 3.

2017. Capital homes. 5 14. Accessed 4 12, 2022. https://newcapitaltoday.blogspot.com/2017/05/NewCapitalEgypt_7.html?m=1.

Days, Dejlige. 2018. Car Sharing in Copenhagen (and other parts of Denmark). 10 4. Accessed 12 25, 2022. https://dejligedays.com/2018/04/10/car-sharing-in-copenhagen-and-other-parts-of-denmark/.

Ekman, Ulrik. 2015. Design as topology: U-City. (pp. 177-201).. Vol. 5, in In Media art and the urban environment. Future City, 177-201. Springer, Cham. doi: https://doi.org/10.1007/978-3-319-15153-3_9.

Elfatah, Ahmed Saleh Abd. 2018. "Approaches and strategies for Enhancing transformation to smart cities."Constraints and challenges"." International Journal of Development 7 (1): 155-176.

Europe, United Nations. Economic Commission for. 2015. Sustainable Urban Mobility and Public Transport in UNECE Capitals. UN.

Fayed, Lina, Abeer Elshate, and Rowaida Rashed. 2019. "Copenhagen: A Model for Regenerative Cities." Architecture and Urbanism: A Smart Outlook. Cairo, Egypt.

Gunn, Amy. 2018. Bicycle Planning in European Cities and Its Applicability to American Cities. California Polytechnic State University, San Luis Obispo College of Architecture and Environmental DesignCity and Regional Planning.

IEA, A. 2013. A Tale of Renewed Cities:A policy guide on how to transform cities by improving energy efficiency in urban transport systems. Paris: International Energy Agency.

Infunti, Massimo, and Lepiniot Ioanna. 2020. Mobility Management A guide of international good practices. Geneva.: United Nations Economic Commission for Europe. https://trid.trb.org/View/1703225 .

Infunti, Massimo, and LEPINIOTI Ioanna. 2020. Mobility Management A guide of international good practices. United Nations.

Khaddour, Raslan. 2008. "Environmental Investments and Their Economic Effects." Tishreen University Journal for Research and Scientific Studies Economic and Legal Sciences Series 30 (5): 37-51.

Kinigadnera, Julia, Benjamin Büttnera, Gebhard Wulfhorsta, and David Valeb. 2020. "Planning for low carbon mobility: Impacts of transport interventions andlocation on carbon-based accessibility." Journal of Transport Geography 87.

Knupfer, Stefan M., Vadim Pokotilo, and Jonathan Woetzel. 2018. Elements of success:Urban transportation systems of 24 global cities. New York: McKinsey & Company.

Kolotouchkina, Olga, and Gildo Seisdedos. 2018. "Place branding strategies in the context of new smart cities:Songdo IBD, Masdar and Skolkovo." Place Branding and Public Diplomacy 14 (2): 115-124.

2023. KPF. 12 2. https://www.kpf.com/projects/new-songdo-city .

Lee, Sang Keon, Heeseo Rain Kwon, HeeAh Cho, Jongbok Kim, and Donju Lee. 2016. International Case Studies ofSmart Cities Songdo, Republic of Korea. Inter-American Development Bank.

Metwally, Eman. 2022. "The role of indicators in evaluating The New Administrative Capital of Egypt." SSRN. doi:http://dx.doi.org/10.2139/ssrn.4030257 .

Minh, Nguyen Quang. 2016. "Application of "Car-Free City" and "City of Short Walks" to living quarters in Hanoi towards sustainable mobility and logistics." Procedia engineering (146): 284-291.

Mirabella, Stefania, Fotini Kehagia, and Constantinos. S Psomopoulos. 2019. "Solar pavement: a new source of energy."." In Bituminous Mixtures and Pavements VII, 441-447. CRC Press.

Mohammadian, Hamid Doost, and Fatemeh Rezaie. 2020. “Blue-Green Smart Mobility Technologies as Readiness for Facing Tomorrow’s Urban Shock toward the World as a Better Place for Living (Case Studies: Songdo and Copenhagen).” Technologies 8 (3).

Najdovski, Christophe. 2017. “The sustainable urban mobility policy of Paris.” 4th European Conference on Sustainable Urban Mobility Plans. Dubrovnik, croatia.

Nasreldin, Rania, and Dalia Abdelfattah. Jan 2020. "Toward Biophilic Egyptian Cities.The Case of New Administrative Capital in Egypt." Journal of Urban Research 35.

2022. New Urban communities Authority. 3 13. http://www.newcities.gov.eg/know_cities/NewCapital/default.aspx.

Patel, Maharshi, and Himanshu Padhya. 2021. “A Smart City Development Concept: The Songdo Experiences. , 9, 7-10..” International Journal of Research in Engineering and Science 9 (1): 7-10.

Qamar, Muhammad Zaid, Mariya Noor, Wahid Ali, and muhammed Obaid Qamar. 2020. "Green Technology and its Implications Worldwide." The Inquisitive Meridian – Multidisciplinary Journal 3 (1).

reda, Hassan. 2022. العاصمة الإدارية تُشارك فى مؤتمر المناخ COP27. 11 7. Accessed 7 5, 2023. https://www.gomhuriaonline.com/Gomhuria/1159307.html.

Rehan, Ghada. 2012. Towards sustainable technological cities Case study of New Songdo City, South Korea,.

S´anchez, Francisco García, and Dhanapal Govindarajulu. 2023. “Integrating blue-green infrastructure in urban planning for climate adaptation: Lessons from Chennai and Kochi, India.” Land Use Policy 124 (106455).

Samuels, Sophia, and Altinay Karasapan . 2014. Copenhagen: a Case Study of one of the Most Sustainable. Colby Liberal Arts Symposium.386. https://digitalcommons.colby.edu/clas/2014/program/386.

Serag, Yehya M. 2017. “THE NEW ADMINSTRATIVE CAPITAL OF EGYPT A CRITICAL REVIEW FROM THE REGIONAL PERSPECTIVE.” Towards A Better Quality of Life. Egypt.

Singh, Amita, Baalsrud Hauge Jannicke , Wiktorsson Magnus , and Upadhyay Utkarsh . 2022. “Optimizing local and global objectives for sustainable mobility in urban areas.” Journal of Urban Mobility 2 (100012). doi:https://doi.org/10.1016/j.urbmob.2021.100012.

TMF. 2017. Copenhagen city of cyclists .the bicycle account 2016. Copenhagen: City of Copenhagen,Technical and Environmental AdministrationMobility. https://bicycleinfrastructuremanuals.com/manuals4/CPH%20bicycle-account-2016.pdf.

Transport., Department for. 2019. Future of Mobility: Urban Strategy. OGL. https://www.gov.uk/government/publications/future-of-mobility-urban-strategy.

2022. Wikipedia. 3 3. https://en.wikipedia.org/wiki/Paris#Urbanism_and_architecture.

Wimbadi, Ramanditya Wimbardana, Djalante Riyanti , and Mori Akihisa. 2021. “Urban experiments with public transport for low carbon mobility transitions in cities: A systematic literature review (1990–2020).” Sustainable Cities and Society 72 (103023). doi:https://doi.org/10.1016/j.scs.2021.103023.