DOI : https://doi.org/10.56452/7-12-40

ISSN: 0974-5823 Vol. 7 No. 12 December, 2022

International Journal of Mechanical Engineering

Collaborate to Generate a more Sustainable and Smart New Capital City

Reham Eldessuky Hamed
Assoc.Prof. Beni-Suef University, Architecture Dep., Faculty of Engineering, Beni Suef, Egypt.
Email: Reham011299@eng.bsu.edu.eg, R_dessuky@yahoo.com, Dr.reham@aucegypt.edu

Ayah Mohamed Ramadan
Lecturer, architecture department at the modern academy Engineering and Technology
Ayahezzat54@gmail.com

Abstract: Egypt, like other countries around the world, is currently working on sustainable smart cities. Additionally, the global trend is towards integrating smart architecture with environmentally sustainable communities to combat climate change, reduce pollution, maintain ecological balance, and meet the needs of a healthy and comfortable life. The study focuses on the fundamentals of transforming cities into sustainable smart cities, which significantly affect real estate investment in light of the current global economic and environmental conditions. The Egyptian architectural community currently divides into supporters and opponents of the concepts of designing the new capital, which requires an objective analysis of the development possibilities of the existing situation and recommendations for the parts in the progress of the emerging new capital. The study is about the new capital and, particularly, the existing cooperation to develop recommendations to achieve a sustainable smart city while respecting the existing determinants. Moreover, a special focus on sustainable development measures will improve the environmental quality of the city.

***Keywords**:* Smart sustainable city, Egypt New Capital, Declared Architectural Vocabulary, Sustainable Development Goals, Cities Design Concepts, Environmental Assessment Methods.

1. Introduction

Smart, environmentally sustainable cities are becoming increasingly common in the building field as people become more aware of climate change and the environmental consequences of building operations [1]. According to the literature, the majority of sustainable efforts focus on green and ecosystems concepts, which requires examining current green building developments to take sustainability goals to the next level. The aforementioned are going to be accomplished by assessing the current situation of buildings, activating them to be environmentally friendly towards green, sustainable cities, and transforming cities into environmentally conscious communities and cities within a broader framework [2]. As a result, greater collaborative efforts are needed to promote balance and sustainable environmental development in new cities and capitals. The architectural approach is currently turning to the biophilic and biomimicry architecture concepts as a way to establish a harmonious relationship between nature, humanity, and architecture. By reviewing the previous literature, architects seek to link the internal environment of the building and the city with the natural environment, as the world has become in need of environmentally friendly cities, by expanding the methods of sustainability in design and approaching the foundations of design on an architectural and urban scale.

Climate change, as well as the water and energy crises, have led to the development of ecological buildings and sustainable structures as a response to the global environmental crisis. Green building is a relatively new concept in Egypt, but it has gained a lot of attention and acceptance on a global and regional level. The main objective is to focus on smart city approaches and briefly discuss the changes formulated to make the city more sustainable. Smart and environmentally sustainable cities have characteristics such as technologically advanced infrastructure, environmental protection plans, efficient and functional public transportation, city plans that are comfortable and advanced in nature, and residents with disabilities who can live and work in the city and make the most of its resources [3]. Climate change and ecosystem imbalances make our world more vulnerable to various environmental consequences. The population is increasingly concerned about the Earth's ability to deal with the negative effects of greenhouse gas emissions, global warming, pollution, natural resource depletion, land use, energy use, and waste generation. This requires reaching methods for understanding and evaluating sustainable architecture in

DOI : https://doi.org/10.56452/7-12-40

new capitals based on the effect of applying the principles of sustainability on simulating urban landscapes and the surrounding natural environment.

The architectural concepts of the new city rely on research to verify that they meet the patterns and standards required to reach a strategy for designing and evaluating cities and simulating nature to achieve sustainability, quality of life, and power conservation, alongside developing the successful revenue of the population and the city. Such evaluation necessitates evaluating the current situation objectively without praise or attack to reach performance and dependence rates and monitor adaptation to the environment to boost an individual's standard of daily life and Well-being in general.

2. Sustainable Smart Cities Characteristics

Sustainable green urbanization entails a set of guidelines and procedures dependent on performance strategy, strengthening circumstances for the future, saving presented resources, and decreasing energy usage. Instead of purely architectural and urban expediency thinking, sustainable development is the application that works to improve performance. By creating resources for energy, water, and materials without producing emissions in the life cycle of facilities and site selection for more effective design, construction, operation, and maintenance [4]. The terms green architecture, environmental architecture, and green buildings are synonyms for designing buildings that have less impact on disturbing the ecosystem and life cycle. Smart cities have enormous contemporary advantages, along with many problems. An urban area is considered smart when municipal operations and services, including medical facilities, educational processes, transit tools, parking methods, and power lines, are all instances of services provided by the government [5]. Infrastructure is also provided to supply data and interaction technology for greater performance as well as ease of operation. A sustainable smart city is made up of various factors, as shown in Fig 1. [6].

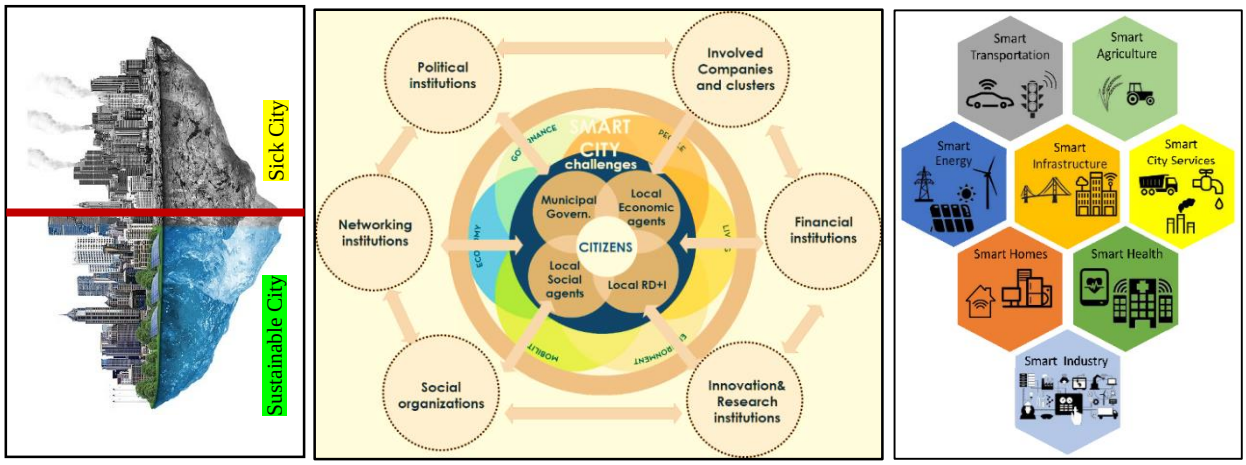


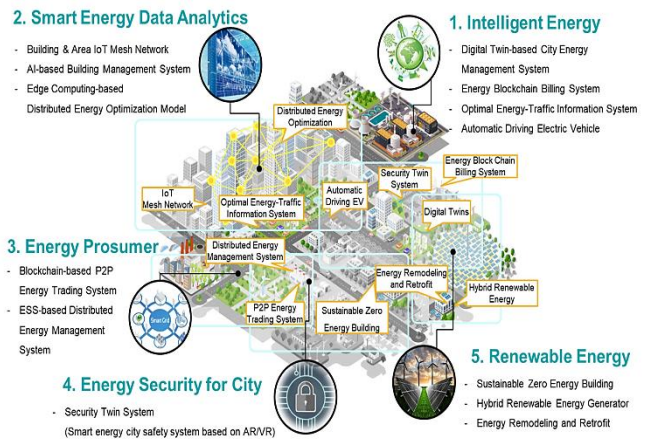
Fig 1. Internal and External Smart City Individuals and Organizations

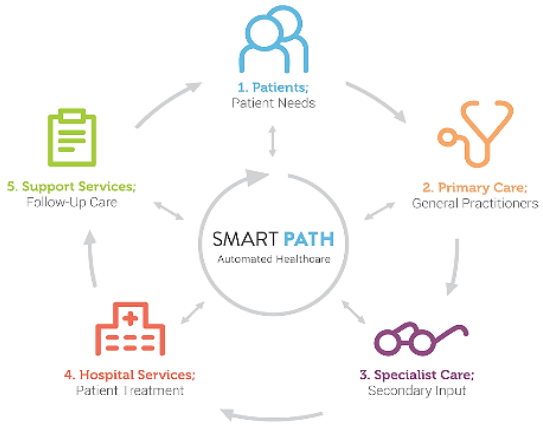
The following subsections discuss a few components that are common to the majority of sustainable smart cities, as shown in Table 1.

Table 1. Smart Sustainable City Components

Smart Sustainable Energy	Smart Sustainable Healthcare
Every service necessitates the use of electricity. Diverse energy sources that are either environmentally friendly or not. This necessitates the availability of smart energy and assembly units, as well as consumer satisfaction and the conservation of renewable energy [7].	Healthcare systems face many challenges in providing high-quality services at a lower cost. Currently, the problems are exacerbated by population growth and the spread of disease. The system includes patient demands, overall services, and hospital and support solutions [8].

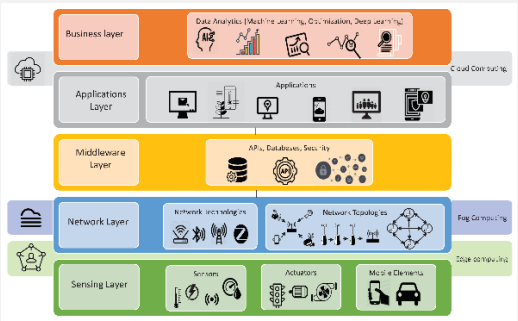
DOI : https://doi.org/10.56452/7-12-40





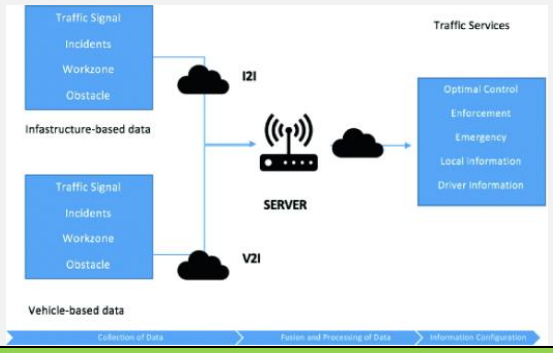
Smart Community

Smart societies strive to improve people's satisfaction, well-being, and life security. By offering services as well as water and waste management systems. Facilities, infrastructure, and services are all part of smart societies.



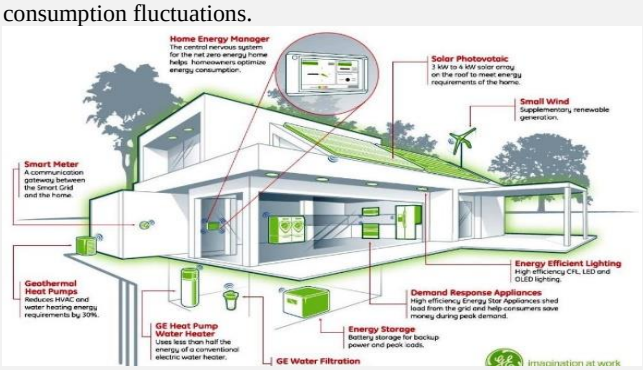
Smart Transportation

The creative system aims to improve the satisfaction and well-being of citizens in cities. The imaginative structure connects a wide range of intelligent constructions



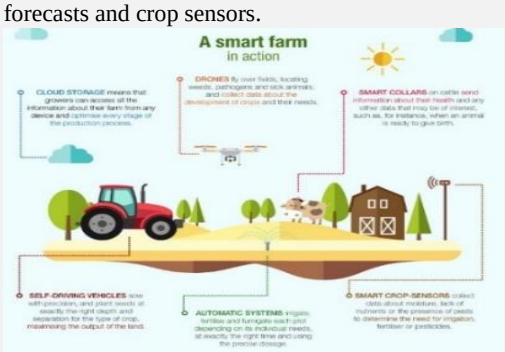
Smart Home

The smart facility employs a specialized control unit to integrate operating systems and the controls can be programmed to respond to power supply signals to reduce energy consumption when the power grid is unstable due to high load demand or even energy consumption fluctuations.



Smart Agricultural

The application of technology has a positive impact on agriculture and livestock towards better environmental sustainability and includes preserving resources such as irrigation water and making the most of land, which reduces environmental impact. Save water: weather forecasts and crop sensors.



DOI : https://doi.org/10.56452/7-12-40

3- The Egyptian New Urban Communities

Within the last 50 years, various governments have made decisions to create new urban communities to control population growth. As a result, as illustrated in Fig 2, investments have been allocated to the development of many new urban areas [9].

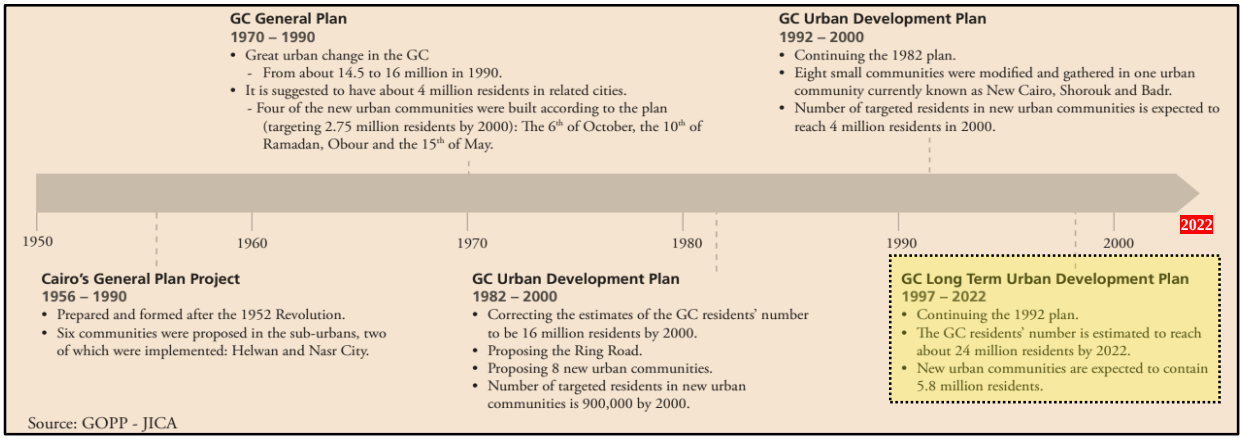


Fig 2. Historic Development for Establishing New Urban Communities

Because of supply and demand challenges, people moving to new communities as a whole are normally much slower than expected. Likewise, the lack of a transportation network, the lack of services, and the remoteness of workplaces from residences Therefore, most of the new urban communities did not succeed in attracting the target number to relieve the main capital requirements. Fortunately, the principles and frameworks for environmentally friendly smart cities, as well as the technologies implementation as well as their influence on settlements are unclear. To transform into smart, sustainable cities, the academic community and decision-makers must collaborate and participate. By adapting the current capabilities and taking into account the global economic conditions to find out the actual problems for the possibility of solution and development. Fig 3 shows the land allocation strategies in the New Urban communities in Egypt.

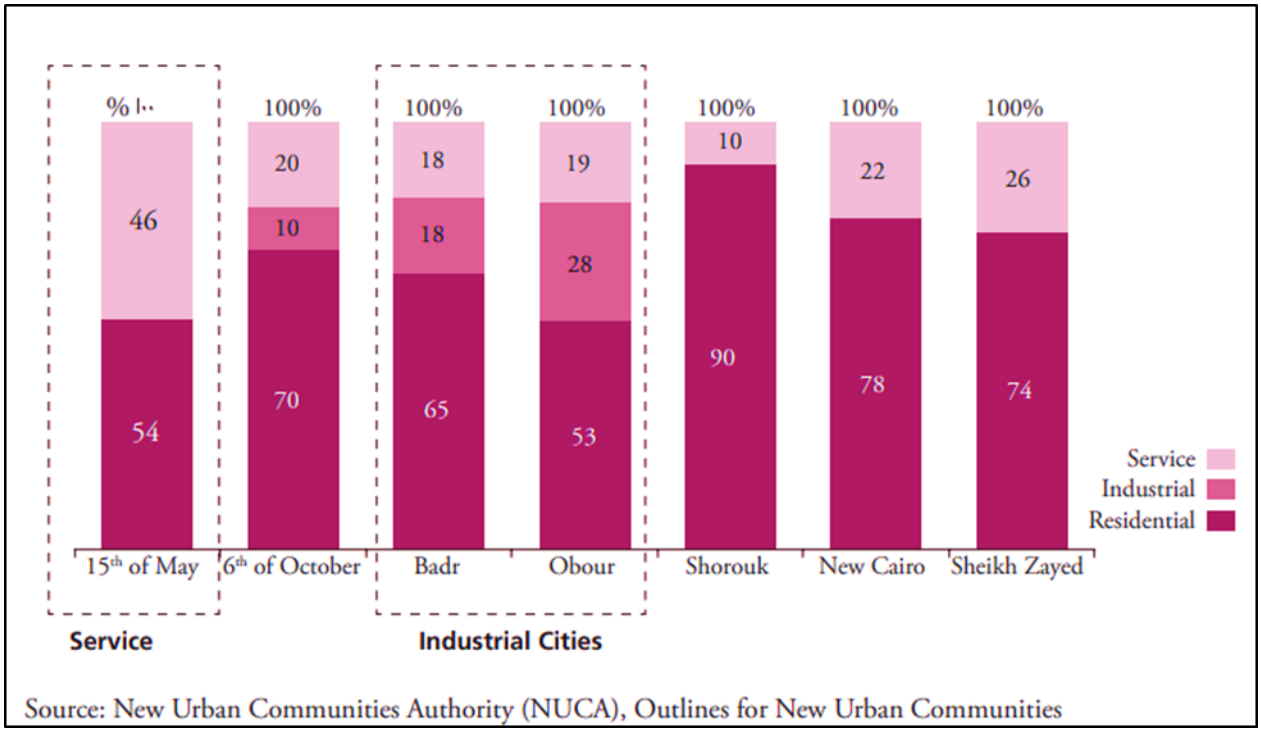


Fig 3. Land Allocation Strategies in New Urban Communities[10].

DOI : https://doi.org/10.56452/7-12-40

The new capital's urban development plan aims to create a multi-polar urban area and nodes, which needs to support by the construction of new attractive centers and future urban development areas. Whereas the zones between the core urban mass and the new communities, including deserts and lands, are considered interstitial buffer zones, which control future urban growth. Fig 4 depicts the urban development pivot strategy in the new capital.

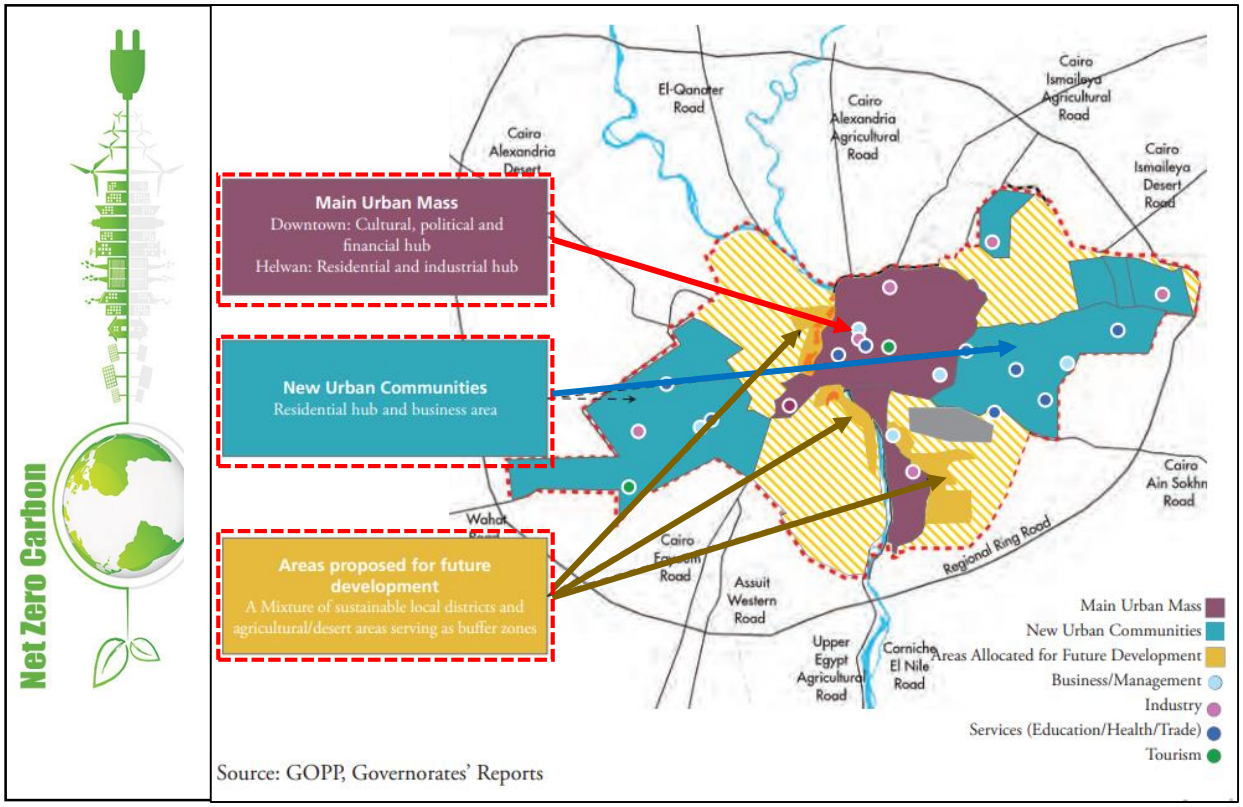


Fig 4. New Capital Urban Development Plan

The significance of sustainable smart cities comes from the use of digital technology to resolve environmental and energy problems while simultaneously making citizens' lives more convenient. Nevertheless, it persists generating problems with technology and components for the city networks. The current situation of Egypt has many development challenges including population, economic, and spatial challenges as shown in Fig 5.

DOI : https://doi.org/10.56452/7-12-40

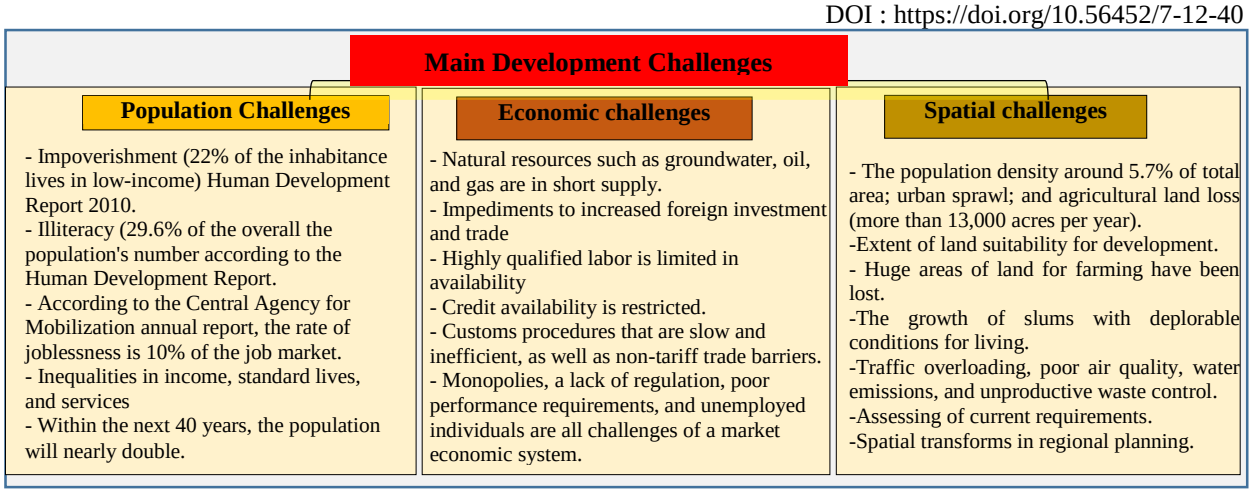


Fig 5. Egypt's Main Development Challenges

4- Egypt's New Administrative Capital

A set of important and well-promoted proposals will serve as the basis for real estate marketing in the new capital and attract customers. There will be a new leadership administrative district, an entertainment trade, and a unique civic location [11]. The new capital has the potential to be an attractive connection between Egypt's flourishing past and energetic future. Where targets focus on the challenges of the old capital to establish a new city with more places to live, work, and invest. If completed as planned, it will address crumbling infrastructure problems in the overcrowded ancient capital. The master plan for the future of Egypt aims to build a universal city with advanced facilities, which opens up a variety of financial market opportunities as well as a high level of luxury spending. Fig. 6 shows the master plan for the development of the new capital.

Fig 6. New Administrative Capital Master Plan Development.

For critical reasons, this location was chosen as an expansion of the current capital. It stretches from east to west between the Cairo highways. Its locate located east of the ring road, near downtown, use and close to the Red Sea as well as provides a logistical and strategic advantage, as shown in Fig 7[12].

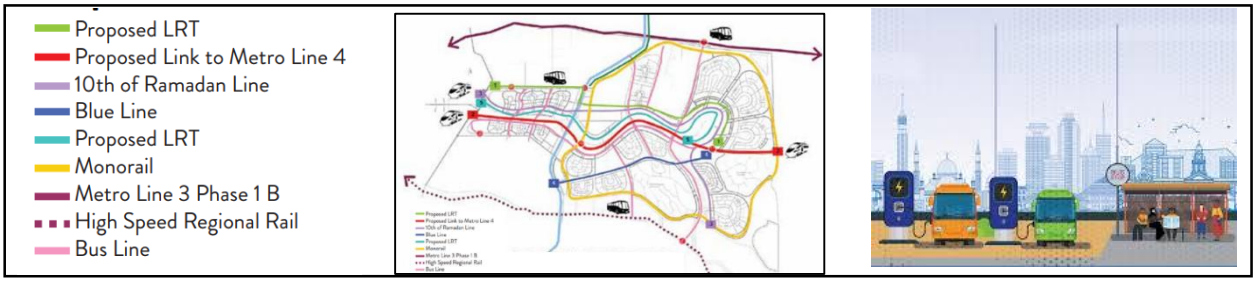


Fig 7. New Administrative Capital Transportation Master Plan.

According to the design company, the planning concept is based on the creation of a vegetated oasis connecting the city's green axes, taking into account the natural environment and site topography, road networks, and rain torrents. As shown in Fig 8, the rainwater drains were converted and treated to become artificial lakes in the recreational axes, and a portion of them are responsible for the Green River's irrigation operations. As a result, and according to the announcements ofthe design and implementation companies, the concept of strategic planning is dependent on integrating the development of the site, road networks, and real estate investment. Aside from the accessibility of numerous economic, commercial, and investment

DOI : https://doi.org/10.56452/7-12-40

activities, such as central business areas, technological industries, sports activities, and specialized institutions [13].

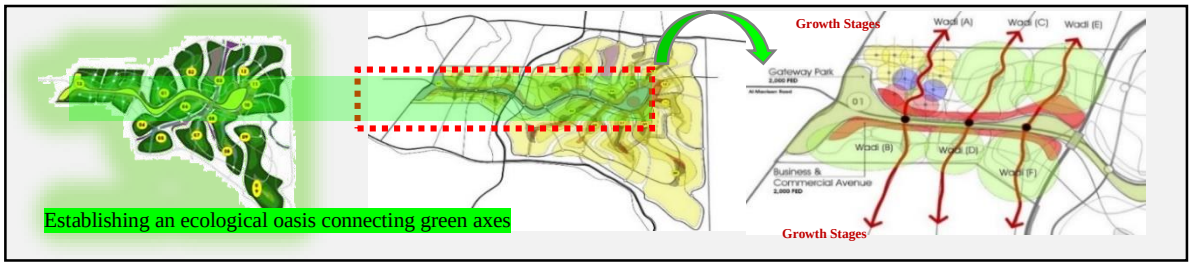


Fig 8. New Cairo's Main Sectors Organize by and Land Usage.

To reflect the personality and distinction of the parts of the Green Axis, it is mediated by 12 green valleys of varying lands, terrain, and activity. Each residential community valley integrates a mix of financial, medium-sized, and high-quality amenities, as well as green, recreational, business, and therapeutic parts [14]. The design companies always announce that the new capital will be a trendy, internationally recognized Egyptian green city that reflects its personality within Egyptian character and civilization. As a bridge for rebuilding their civilization and creating a new life for them, embodying their aspirations for an acceptable life and quality through modern technologies, and the availability of integrated along with contemporary transportation systems and facilities [15]. The approach of establishing a new capital stems from the need to address the overcrowding and deterioration of services in the old capital. The number of residents will grow from 18 million to 40 million by 2050 as the capital expands; it will be Egypt's first smart, sustainable city, as illustrated in Fig 9 [16].

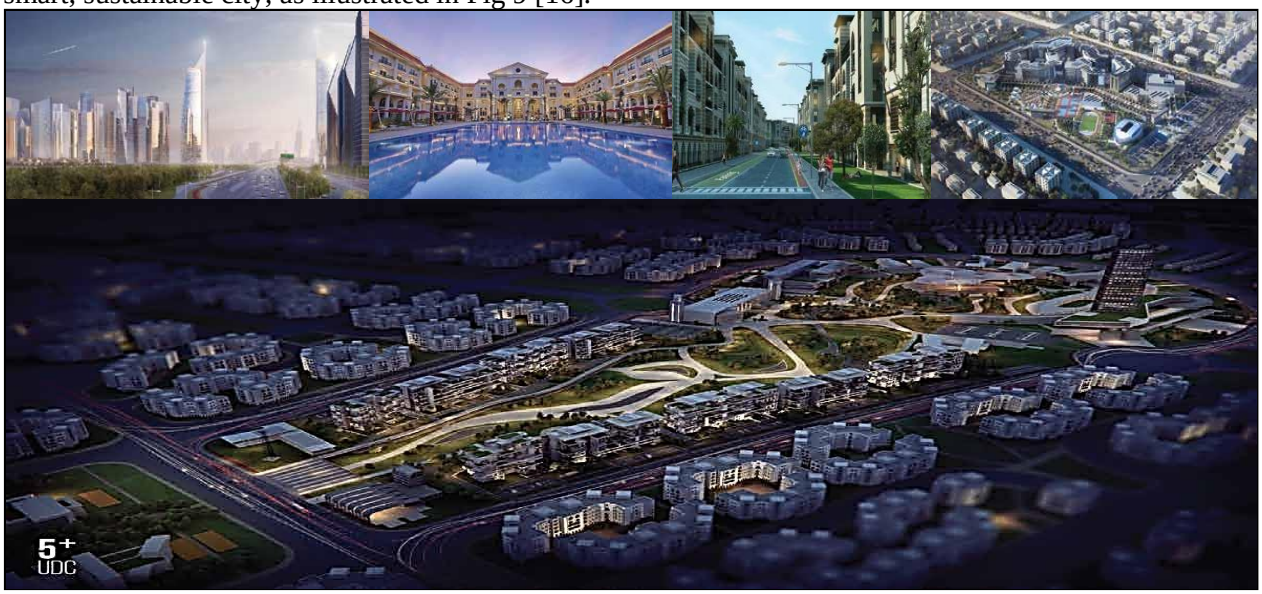


Fig 9. New Administrative Capital Visualization Component Plan.

The project will be accomplished through the Ministry of Housing and the Dar Al-Handasah "consulting workplace," The Ministry of Housing will own the lands around the green river, invest in them, and supply the funding expected for executing the project. Sectors of the middle development axis, which includes three sections depicted in Fig 10 and 11, are: The first section, "CP 01," is about 4 km. long and covers an area of 375 acres, and it includes the Islamic Garden, the covered garden, the social club, the integrated spa, lakes, and restaurants that mimic the surrounding environment. The second sector, "CP 02," is approximately 3 km. long and 306 acres in size. It serves as a cultural and recreational hub. Parks, an artwork park, a heritage park, a recreational games area, celebration squares, and an open theatre are all part of it. The third sector, "CBD," is about 4 km. long and covers an area of 309 acres. It consists of The Central Business District pen library, reading gardens, Central Square, restaurant area, sports club, and entertainment squares for children. According to the findings, a multidisciplinary strategy should be adopted to address several issues, including energy conservation, enhanced material utilization, material consumption reduction, and pollution legislation. Numerous approaches to controlling and improving the existing nature of building activities to make them less environmentally detrimental while maintaining the valuable output of building activities. To obtain an affordable benefit from an environmentally Low-impact construction process, the context practices implemented should be throughout the building process. Three

DOI : https://doi.org/10.56452/7-12-40

major goals should be adopted to set up a system supporting profitable construction while maintaining the values of long-term viability (social, ecological, and financial) [17].

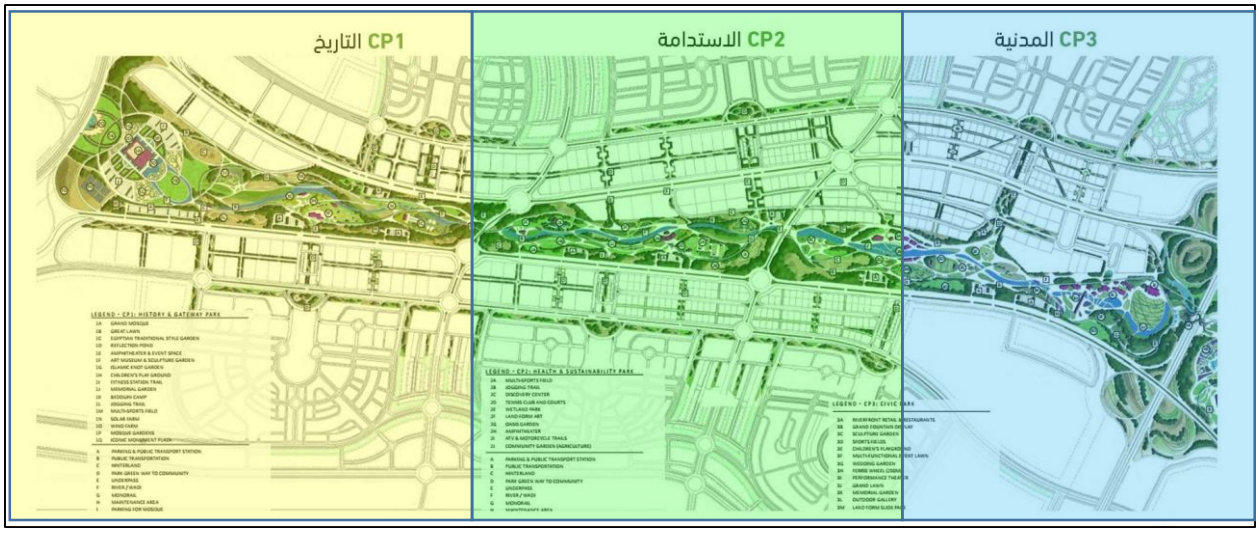


Fig 10. New Administrative Capital general plan [18].

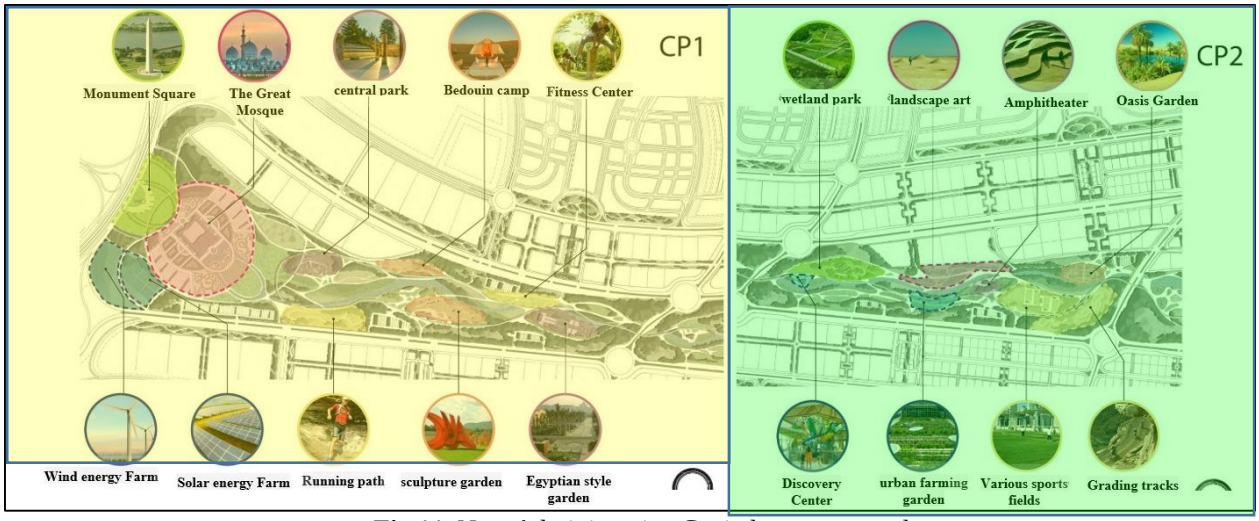


Fig 11. New Administrative Capital component plan.

5- Declared vocabulary for sustainability and intelligence

The Green River philosophy, based on the topography of the area, is compatible with Egypt's overall ecosystem, which values the environment. The concept beyond the new capital was to rebuild the Nile as a green axis in the middle of the desert, connecting all the surrounding areas, still considering the lifeline that Egyptians had a history of living around it. Which required simulation to attract Egyptians to the new administrative capital. As the axis extends a length of 25 m2 and has a total area of 5,000 hectares to grow into one of the biggest national parks [19]. Central Park, extending along the city's outskirts, reflects the local botanical environment, while also providing recreational opportunities for all residents. It is equipped with modern facilities, communication systems, and intelligent transportation. It was also stated that the capital will be a green space, where work has begun on one thousand acres of the Green River, which seem to have the longest chains of gardens, as shown in Fig 12. Massive central gardens, freely accessible theatres, artificial entertainment lakes, artistic and drawing lakes, library services, restaurants, food courts, and greenery are all components of the green axis.

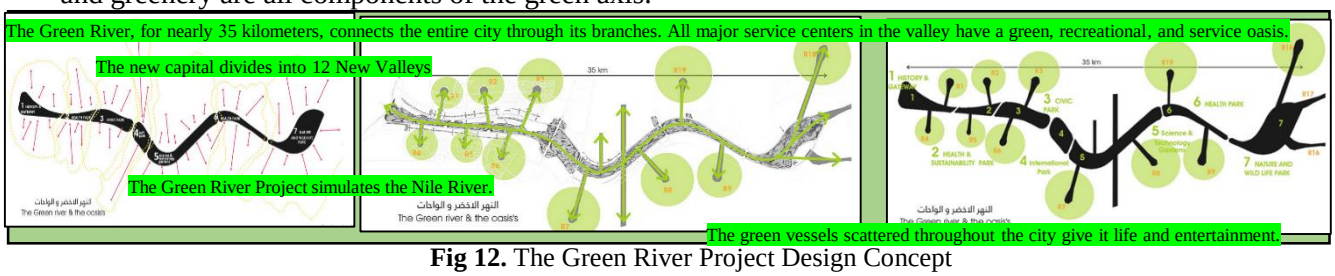


Fig 12. The Green River Project Design Concept

The Solar Cell Farm, aimed to enhance the small stations connected to the network to secure the subsequent generations uniquely distributed from the stations installed in commercial, tourist, residential, governmental, recreational, and investment facilities. As a result, technical assistance and consultations providing as the qualification of cadres to construct 121 power stations in the manufacturing and local industries sectors, covering the needs of various facilities with a total capacity of 9.8 megawatts. The country, project will help Egypt achieve its 2030 vision for environmental community development, with recommendations for diversifying power assets as well as promoting activated clean energy[20]. As a result, Egypt will begin to establish emerging markets for this kind of technology, thereby creating new job opportunities. It will account for around twenty percent of the overall electrical power, as a clean source to gain benefits and count on green energy for cutting emissions. As an example of achieving environmental sustainability for new cities in Egypt, Fig 13 depicts the integration of solar cells with the bus parking shades and the green roofs of the facilities.

Fig 13. New Administrative Capital component plan.

According to the New Urban Communities Authority website, it will be a smart city with a central administration and control center outfitted with smart facilities[21]. Construction and road management systems, transportation administration, parking solutions, services for waste management, and mobile and internet-based applications will be integrated for interaction with individuals and companies. Services related to infrastructure include an optical fiber network and a standard cellular tower. Which requires analysis and study to evaluate the green and technical performance of the existing part of the capital under study [22].

6- Sustainable Performance: A Structure of Approaches and Methods

The new capital has many names Fig 14, including smart, green, energy-saving, sustainable, loving, and carbon-free capital, and it represents a global trend to adapt to climate change and reduce pollution emissions for future generations. The architectural community, divided into supporters and opponents, requires an objective analysis of the development possibilities towards a smart sustainable city.

Fig 14. New Capital Smart Sustainable Concept

The opinions of the architectural, urban, and environmental communities about the efficiency of the performance of the new capital differ between proponents and opponents. This is due to the announcement of the different development titles of the concept: smart, green, sustainable, and so on. In pursuit of critical and objective solutions aimed at developing the current situation towards gradual access to sustainable smart capital. A new capital must follow in the footsteps of sustainable smart cities by establishing a mutual relationship between urban sustainability and architectural environmental intelligence characteristics. A smart, sustainable city uses communications and information technologies for greater citizen satisfaction, the efficiency of urban operations, and the performance of facilities and processes. Although simultaneously guaranteeing the expectations of current and upcoming generations are encountered by closing capacity and efficiency gaps, meeting economic, social, environmental, and cultural needs, and making cities more receptive to breakthroughs and smart sustainable achievements. In pursuit of an objective analysis of the current situation based on design and implementation, companies collaborate on the transformation of an environmentally smart and sustainable city. Due to a lack of clear information and sustainable city methodologies, the architectural community is debating the current state of the new capital. As a result, the research methodology is based on several stages, including a comparison of city design concepts, a New Capital SWOT analysis, adaptability dimensions of environmental assessment methods, a Comparative

DOI : https://doi.org/10.56452/7-12-40

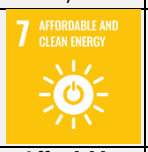
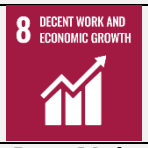
Analysis of the Adaptation of the Smart Green Building Rating System in the New Capital City, and Architect's questionnaire results.

6.1- A Comparison between Cities Design Concepts and Strategies: Society is perplexed about the distinction between sustainable and smart cities. Which requires comprehension of the difference between architectural, environmental, and urban design concepts and strategies. Including all of the following: Building Design, Urban Planning, Construction System, Mobility Services, Materials Resources, Construction System, Indoor Comfort, Energy Consumption, Energy Applications, Waste Management, and Water Management.

Table 2. Comparison of Architectural and Urban Design Concepts and Strategies

City Architectural Concepts	Past /Classical City	Present/Green City	Present/Smart City	Future/ Digital City
Buildings Design	Classic Details	Passive Techniques	Monitoring Systems	Integrated Data Systems
Urban Planning	Context Pattern	Greening per Capita	Smart Infrastructure	Integrated Network
Construction System	Traditional Structure	Low Emissions	Smart Structure	Digital Fabrications
Mobility Services	Traditional Services	Green Low Emissions	Smart Green Services	Integrated Systems
Materials Resources	Traditional Materials	Environmental Friendly	Physical Change	Digital Responsive
Construction System	Traditional Structure	Low Emissions	Smart Structure	Digital Fabrications
Indoors Comfort	Services Only	Environmental Quality	Techniques Integrations	Network Management
Energy Consumption	Inefficient Consumption	Indoors Comfort	Control Systems	Control Units
Energy Applications	High Consumption	Renewable Appliance	Enhance Lifestyle	Digital Lifestyle
Waste Management	Basic Management	Reducing	Efficient Recycling	Efficient Systems
Water Management	Basic Management	Harvesting	Efficient Recycling	Efficient Systems

Smart Sustainable City- Information and Communication Technology of:

3	6	7	8	9	11	12	13
							
Good Health and Well-Being	Clean Water and Sanitation	Affordable and Clean Energy	Decent Work and Economic Growth	Industry, Innovation, and Infrastructure	Sustainable Cities and Communities	Responsible Consumption and Production	Climate Action
Social	Social	Environmental	Economic	Economic	Environmental	Economic	Environmental

City Architectural Principles	GREEN	SMART	SUSTAINABLE
Adapt Climate Disruption Resilience	√	√	√
Clean Fresh Air Quality	√	√	√
Green Sustainable Economy	√	√	√
Energy Efficiency Conversation	√	√	√
Environmental Energy Control	√	√	√
Green Growth Development	√		√
Greening of Cities and Buildings	√		√
Citizens' Health Coverage Defense	√	√	
Information Communication Technology	√	√	√
Land Utilizations and Spatial Optimizations	√		√
Natural City Strategies Solutions	√		√
Environmental Impact Assessment	√		√
Community Effectiveness and Protection	√	√	√
Community Smart Skills		√	
Smart Government Economy		√	
Community Smart Life Style		√	
Community Unity	√	√	√
Community Sustainable Development	√	√	√
Community Inclusive Architecture Planning	√	√	√
City Water/ Waste Superintendence	√	√	√

The smart, sustainable city employs intelligence to create a set of features that strengthen sustainability-oriented possibilities while simultaneously concentrating on creating an equitable community and upgrading the standard of our lives. This necessitates the incorporation of technological approaches in the establishment of facilities promoting environmental responsibility and satisfying the demands of citizens. As well as all educational, wellness, power, and transport facilities. Furthermore, it meets the financial, social, ecological, and cultural requirements of current and future generations as well. To assess the current situation of the city under consideration, it is necessary to evaluate the city's advantages, deficiencies, potential, and barriers to Working together regarding Smart Sustainability methodology, as shown in Fig. Fig. SWOT Analysis of New Capital.

DOI : https://doi.org/10.56452/7-12-40

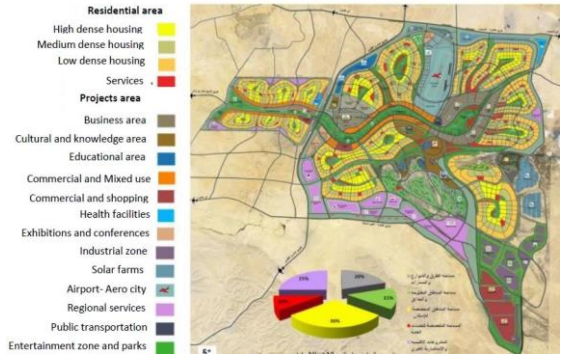
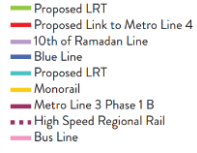
6.2- New Capital SWOT Analysis

Fig 15. New Capital SWOT Analysis

DOI : https://doi.org/10.56452/7-12-40

6.3- Adaptability Dimensions of Environmental Assessment Methods: There are numerous determinants influencing adaptation because of the environmental assessment results. Including challenges assessments, climate change, adaptation techniques, and sustainability principles of sustainable smart architectural environmental cities. Smart, saving energy, sustainable, and carbon-neutral are all definitions for designing cities, which symbolize a worldwide movement for responding to the effects of climate change and decreasing emissions of pollutants for the coming generations. Table 3 shows the aspect of smart sustainability evaluation approaches to transformation.

Table3: Dimension of Adaption Of Environmental Assessment Methods

Challenges Assessment	Climate Change Adaptation		
Lack of awareness	Smart		Energy Management In New Capital City
Deficit of social services	Smart Economy		Transportation In New Capital City
Lack of urban economy diversification	Smart Mobility		Water Management In New Capital City
Climate change effect	Smart People		Waste Management in New capital city
Urban violence and insecurity	Smart Governance		Sources of Energy in New capital city
Threats to cultural identity	Smart Living		Solar Energy/ Green River
	SUSTAINABILITY PRINCIPLES		
	Urban and Functional Sustainability	  	
	Social Sustainability		
	Environmental Sustainability		
	Economic Sustainability		
	City design principles		
Targets 	 	
Transportation and access network 	 	

- There are many different approaches to evaluating and classifying environmentally friendly cities; therefore, the comparison must be prepared to arrive at the research approach [23,24]. The following table 4 depicts the green building classification system: The weight of the BREEAM, LEED BD+C, Pearl Rating System, TARSHEED, and Egypt Green Buildings rating systems.

Table 4: Comparative Analysis of the Adaptation within the Smart Sustainable Assessing Framework

CLASSIFICATION	SUBJECTS	INTERNATIONAL RATING SYSTEMS			EGYPT RATING SYSTEMS	
A Comparative Analysis of the Sustainable Construction Evaluation System Transformation in the New Capital City		BREEAM UK	LEED BD+C v4	PRS for ESTIDAMA v1.0	TARSHEED Residential v1.0	GPRS Public Review
Site Selection	Choosing a Location and Utilizing Land.	✓	✓	✓	✓	
	The Location Assessment, Ecological Method Procedure		✓	✓		✓
	Building Operations and Pollution Elimination	✓	✓			
	Light Emission Reducing, Complete Turn-Off Lighting Outside		✓	✓		✓
	The Safeguarding of Ecological Systems, Values, and Features		✓	✓	✓	✓
	Parking Signs and Protected		✓		✓	✓
	Access, Bikes Stands, Alternative Ways of Transport, and Routes	✓				✓
WATER	Water Supply Usage	✓	✓	✓	✓	✓
	The Indoor Water Preservation		✓	✓	✓	✓
	The Outdoor Water Preservation		✓	✓		✓
	Water Different Levels Meters for Construction	✓		✓		✓
	Water Conservation in Landscaping and Irrigation	✓		✓	✓	✓
MATERIALS	The Lifetime Assessment	✓				✓
	Reusing Preservation and Gathering		✓	✓	✓	
	Insulation Material Resistance	✓				✓
	Reusing Supplies and Constructions		✓	✓	✓	✓
	The Countryside Local Supplies		✓	✓	✓	
	The Systemic Modules Flooring			✓		✓
INDOOR ENVIRONMENTAL QUALITY	Visual Convenience, Natural Light, Reflections, and Anti-Reflective Strategies	✓	✓	✓	✓	
	Thermal convenience, Loss/Gain	✓	✓			✓
	The Acoustics functionality/Performance	✓	✓		✓	✓
	The safeguarding and safeguard operation	✓			✓	✓
	Improved Indoor Environmental Fresh Air Standards	✓	✓		✓	
	Management control of Internal Air Quality, and pollution sources		✓	✓		✓
	Monitoring Smoking Sources and Operations		✓	✓	✓	✓
	Fresh Air Flow Movement and Circulation			✓	✓	
	Materials Carbon Dioxide Emissions		✓	✓	✓	✓
	Handling Brightness, Reflections, and Glare				✓	
ENERGY	Reducing Emissions, Supplying Green Power, and Carbon Substitution	✓	✓			✓
	Power Monitoring, Verification, Reporting, and Power Delivery Performance	✓	✓	✓	✓	✓
	Mechanisms of Outdoors and Exterior Illumination	✓				✓
	Low /Zero Carbon, Global Warming, Emissions, and Environmental Impact	✓		✓	✓	✓
	Power Efficient Cold/ Refrigeration Process, Ozone Effects, and Fire Prevention	✓	✓	✓	✓	
	Efficient Transportation Systems, Lifts, and Energy-Efficient Building Services	✓		✓	✓	✓
	Energy-Saving Methods, Systems, and Techniques	✓		✓	✓	

	Limited Energies Efficiency, Operations, and Control Mechanism		✓	✓	✓	
	Smart Energy Monitoring and Constructing Level Energy Measurement		✓		✓	✓
	Performance Response to Energy Demand		✓	✓	✓	✓
	External Gain/Loss Decreasing Techniques, Cool Methods for Building		✓		✓	
	Maintaining and Processes Systems			✓	✓	✓
OTHERS	Strategies of Sustainable Environmental Perception and Conversation			✓	✓	✓
	Heritage Preservation and Identity within Cultures			✓	✓	
	The National Economic Growth and Development Plan Promotes			✓		✓
	The Characteristics of Neighboring Shading				✓	✓
	Limit the dependence on private transport means.			✓	✓	
	An earthquake occurred, and Defense			✓	✓	✓
	Green Originally Automobiles		✓			✓
	A Declaration of Ecological Product Innovation		✓		✓	
	Improving Material Components and Construction Wasts		✓		✓	
	Top Desired Goals and Previous Decisions	✓	✓		✓	
Environment (Climate Change)	Reduce / Eliminate the production of Greenhouse Pollutants	✓		✓		✓
	Eliminates the Disappearance of the Ozone Layer in the Stratosphere	✓	✓	✓	✓	✓
	Reduce the Impact on the SSite'sNatural Environment	✓		✓	✓	✓
Preserve Natural Resources And Waste Management	Reduce Waste Subsequent Generations		✓	✓		✓
	Reduce Primary Energy Consumption		✓	✓	✓	✓
	Control The Consumption Of Raw Supplies	✓	✓			✓
	Reduce The Amount Of Water Usage		✓	✓		✓
	Improve Utilization Of Land	✓	✓			✓
	Captured Power Efficiency	✓	✓	✓	✓	✓

As there are no clear methodologies at the academic and executive levels, global and local sustainability classifications have been used to develop criteria for evaluating smart, sustainable cities. Accordingly, it was conducted to help identify the determinants and identify problems at all levels. Rating systems include Site Selection, water management, used materials, indoor environmental quality, Energy state, climate change, and waste management. It should be noted that the evaluation was based on communication with the design firm and implementing agencies, as well as site visits. The goal of the study, however, is to use the methodology for evaluating and developing the Egyptian Green Pyramid. Moreover, for executive decisions to be adopted and evaluated based on facts, especially in the construction, development, and investment fields, the state is capable of doing so. Furthermore, the new capital is still under construction and in its early stages of establishment, so the evaluation is based on reality as well as assurances from officials and decision-makers for the design and implementation of cooperation to achieve the desired goal. Whereas existing research aims to provide information and analyze it in the form of methodologies derived from analyses, questionnaires, and codes to be used in current and future stages. The purpose of the research is not to applaud or criticize a project that has already begun; rather, the goal is to collect enough real data for evaluation. The research recommendations are intended to assist the academic and executive communities in developing the most appropriate solutions for such an emerging type of city in the Egyptian context. Because of the importance of communicating with the architectural community and decision-makers about the discussions of the new smart, sustainable capital. A survey was created to collect and consider the opinions of construction experts in light of available and declared information. Also offered to collaborate to activate intelligence and sustainability standards with the current situation of challenges, shortcomings, and advantages.

DOI : https://doi.org/10.56452/7-12-40

6.4- Architect's Questionnaire: To conduct this green pyramid rating scheme analysis, we developed a questionnaire based on the existing category and sub-category list. Environmental architects and government sector workers in New Capital City were requested to validate the questionnaire and make any necessary changes in categories, credits, and format. Table 5 illustrates a pairwise scale that indicates the significance of variables, with values ranging from 1 to 5 indicating the relative importance of each criterion to the other alternatives. The following table displays the participants' Green Pyramid awareness on a scale of 1-5. The following table shows the seven green pyramid aspects of the architectural section with various architect experts using different charts with different scales.

Table 5: Scores for the significance of variables**.**

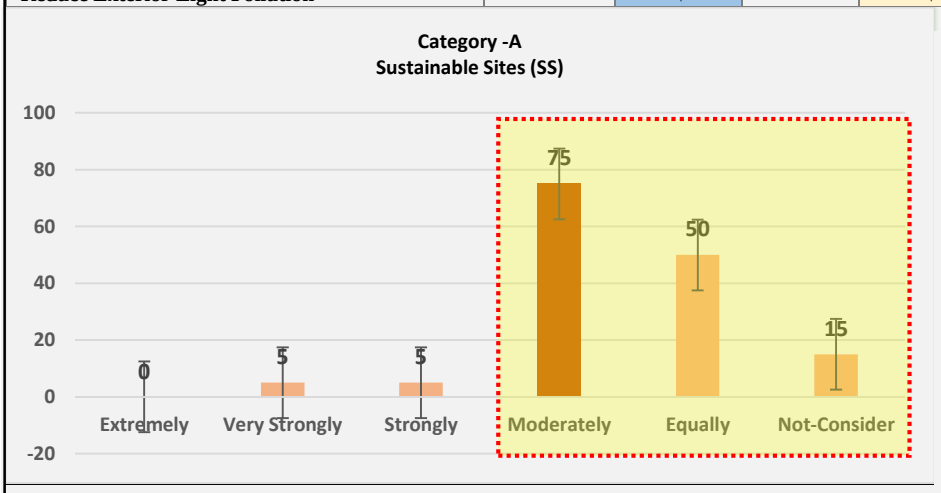
Important Scale	Definition of Important Scale
0	Not-Consider
1	Equally
2	Moderately
3	Strongly
4	Very Strongly
5	Extremely

Sample questionnaire for the analytical pyramid process- Number of Architects= 150

Category -A	Category -B	Category -C	Category -D	Category -E	Category -F
Sustainable Sites (SS)	Energy and Atmosphere (EA)	Water Efficiency (WE)	Materials & Resources (MR)	Indoor Environmental Quality (IEQ)	Waste Management (WM)

Table 6: Checklist of the Proposed Green Building of Sustainable Sites (SS)

Checklist: Sustainable Sites (SS)						
Scale	Extremely	Very Strongly	Strongly	Moderately	Equally	Not-Consider
Building Exterior and Hardscape Management						√
Substitution of the Transportation Plan			√	√		
Site Improvement				√		√
Process of Storm/Rainwater Design and Control.				√		√
Heat Island Effect and Surroundings Effects					√	
Reduce Exterior Light Pollution		√		√		



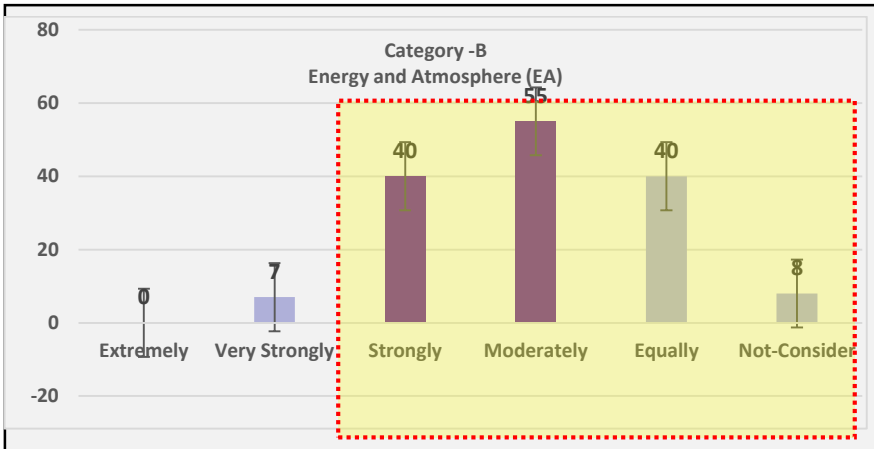
Category -A
Sustainable Sites (SS)

Graphs show that the questioner SS has about 75 people with moderate level and 50 people with equally level which shows that these aspects do not work well in the new capital city based on pyramid rating system.

Fig 16. Chart of participant percentage towards Sustainable Sites (SS).

Table 7: Checklist of the proposed green building of Energy and Atmosphere (EA)

Checklist: Energy and Atmosphere (EA)						
Scale	Extremely	Very Strongly	Strongly	Moderately	Equally	Not-Consider
Energy Performance Reduction			√	√		
Current Building Contracting Examination					√	
Renewable Energy Sources				√		
Improve Ventilation Performance						√
HVAC Systems Efficiency						√
Performance Management Building Automation System				√		√
Building Energy Level Metering form						√
Green Power and Carbon Offsets				√		



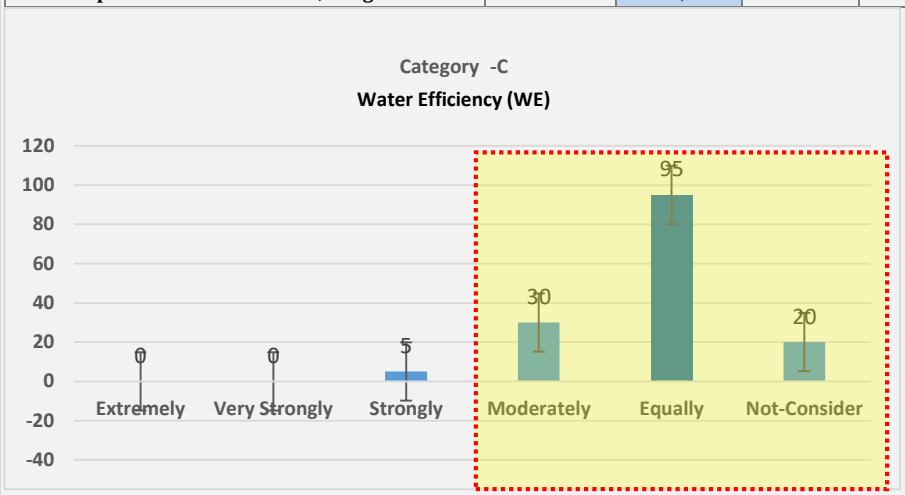
Category -B
Energy and Atmosphere (EA)

The graph illustrates the distribution of the Energy and Atmospheric levels used in the green pyramid rating scheme, which yielded scores of 40, 55 and 40 persons respectively with strongly, moderate, and equally scores respectively. Otherwise, this aspect are the most covered aspects in green pyramids rating system.

Fig 17. Chart of participant percentage towards Indoor Energy and Atmosphere (EA)

Table 8: Checklist of the Proposed Green Building of Water Efficiency (WE)

Checklist: Water Efficiency (WE)						
Scale	**Extremely**	**Very Strongly**	**Strongly**	**Moderately**	**Equally**	**Not-Consider**
Wastewater Reuse			√			
Water Efficient Fixtures				√		
Indoor & Outdoor Use Reduction					√	
Detection of Leaks and Metering				√		
Landscape Water Use Reduction, Irrigation		√				



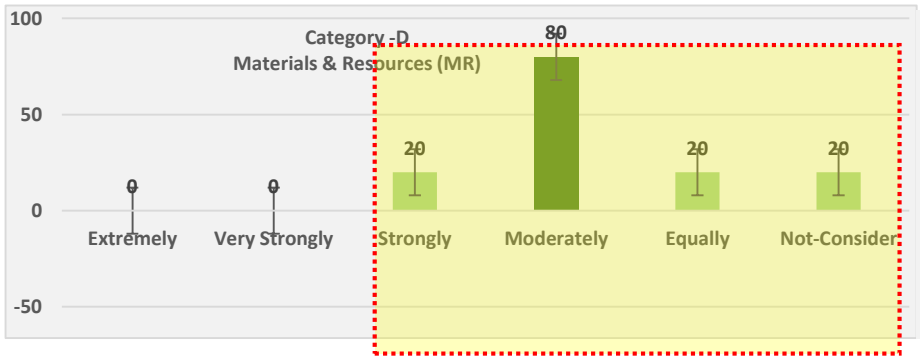
Category -C
Water Efficiency (WE)

The graph represents the coverage of the Water Efficiency (WE level applied the green pyramid rating system which the result rated 30. 95 and 20 persons with, moderately, equally and not-consider respectively. While the water efficiency aspect got the highest level with equally person in the questioner of the study.

Fig 18. Chart of participant percentage in the direction of Water Efficiency (WE)

Table 9: Checklist of the Proposed Green Building of Materials & Resources (MR)

Checklist: Materials & Resources (MR)						
Scale	**Extremely**	**Very Strongly**	**Strongly**	**Moderately**	**Equally**	**Not-Consider**
Using Renewable Energy for Recycling						√
Reduce the total amount of materials used.						√
Environment-friendly, sound, heat-resistant						√
Regionally sourced materials and products.					√	
Life-Cycle Impact Reduction					√	



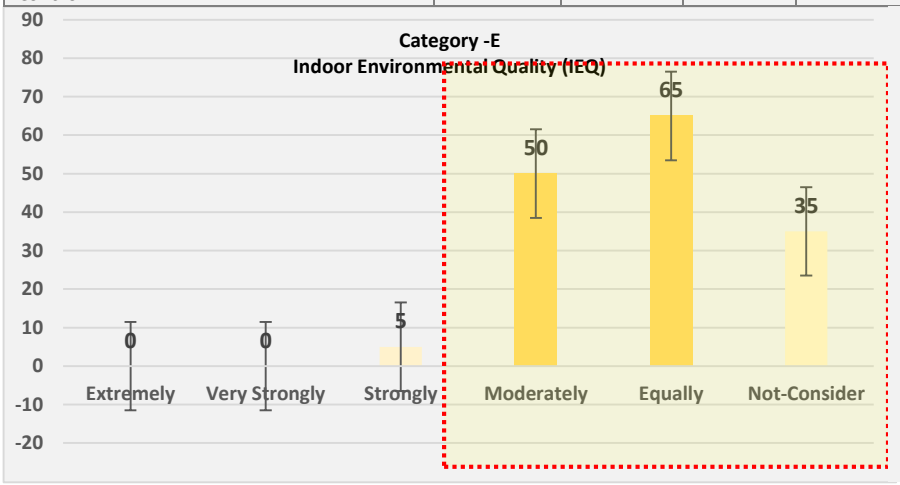
Category -D
Materials & Resources (MR)

The following Figure represents the coverage of the adaptation of material and resources of green pyramid aspects in new capital city. Therefore the moderately levels with 80 person are the highest level achieved in this aspect.

Fig 19. Chart of participant percentage towards Materials & Resources (MR)

Table 10: Checklist of the Proposed Green Building of Indoor Environmental Quality (IEQ)

Checklist: Indoor Environmental Quality (IEQ)						
Scale	**Extremely**	**Very Strongly**	**Strongly**	**Moderately**	**Equally**	**Not-Consider**
Minimum Indoor Air Quality Performance					√	
Management Practices for Indoor Air Quality						√
Light Pollution Reduction			√			
Improve Ventilation process					√	
Thermal Comfort levels					√	
Co2 Emissions			√			
Visual well-being, Daylighting, Glare control						√

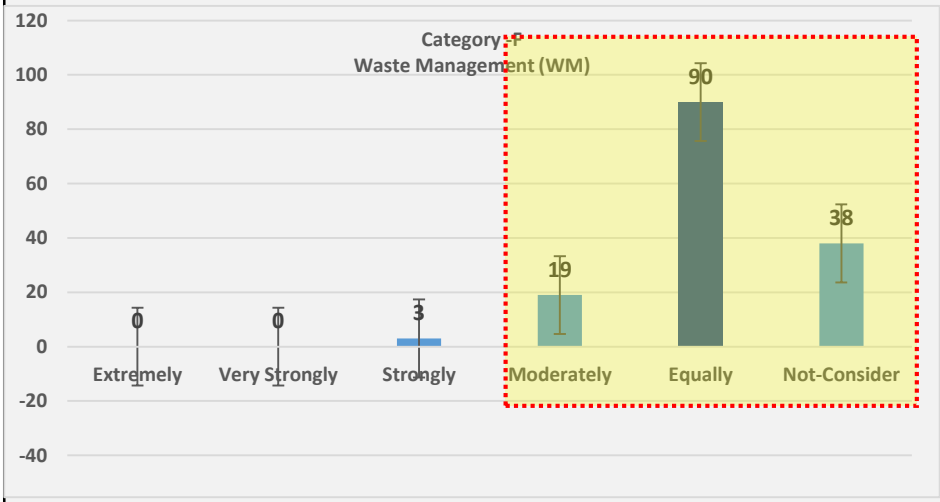


Category -E
Indoor Environmental Quality
Figure 20 show the result of the questioner of the indoor environmental quality with 5 ,50,65 & 35 persons with strongly, moderately, equally and not consider respectively which indicates that the indoor air quality need more enhancement methods to reach to the comfort zone.

Fig 20. Indoor Environmental Quality (IEQ) Participant Percentage Chart.

Table 11: Checklist of the Proposed Green Building of Waste Management (WM)

Checklist: Waste Management (WM)						
Scale	**Extremely**	**Very Strongly**	**Strongly**	**Moderately**	**Equally**	**Not-Consider**
Spaces for the collection and sorting of waste					√	
Contact a specialized waste removal company.					√	
Onsite/Offsite Waste Recycling				√		
Collection of the Recycling storage.				√		
Disposal						√



Category -E
Waste Management (WM)
The results of Figure 21 demonstrate that the aspect of Waste Management within the Green Pyramid achieved the highest rating, with a comparable score to 90 of the questioners.

Fig 21. Chart of participant percentage towards Waste Management (WM)

Table 12: Scores for the significance of variables Chart of participants.

	Extremely	Very Strongly	Strongly	Moderately	Equally	Not Consider
Group -A: Sustainable Sites (SS)	0	5	5	75	50	15
Group -B: Water Efficiency (WE)	0	0	5	30	95	20
Group -C: Materials & Resources (MR)	0	0	20	80	20	20
Group -D: Indoor Environmental Quality	0	0	5	50	65	35
Group -E: Energy and Atmosphere (EA)	0	7	40	55	40	8
Group -F: Waste Management (WM)	0	0	3	19	90	38

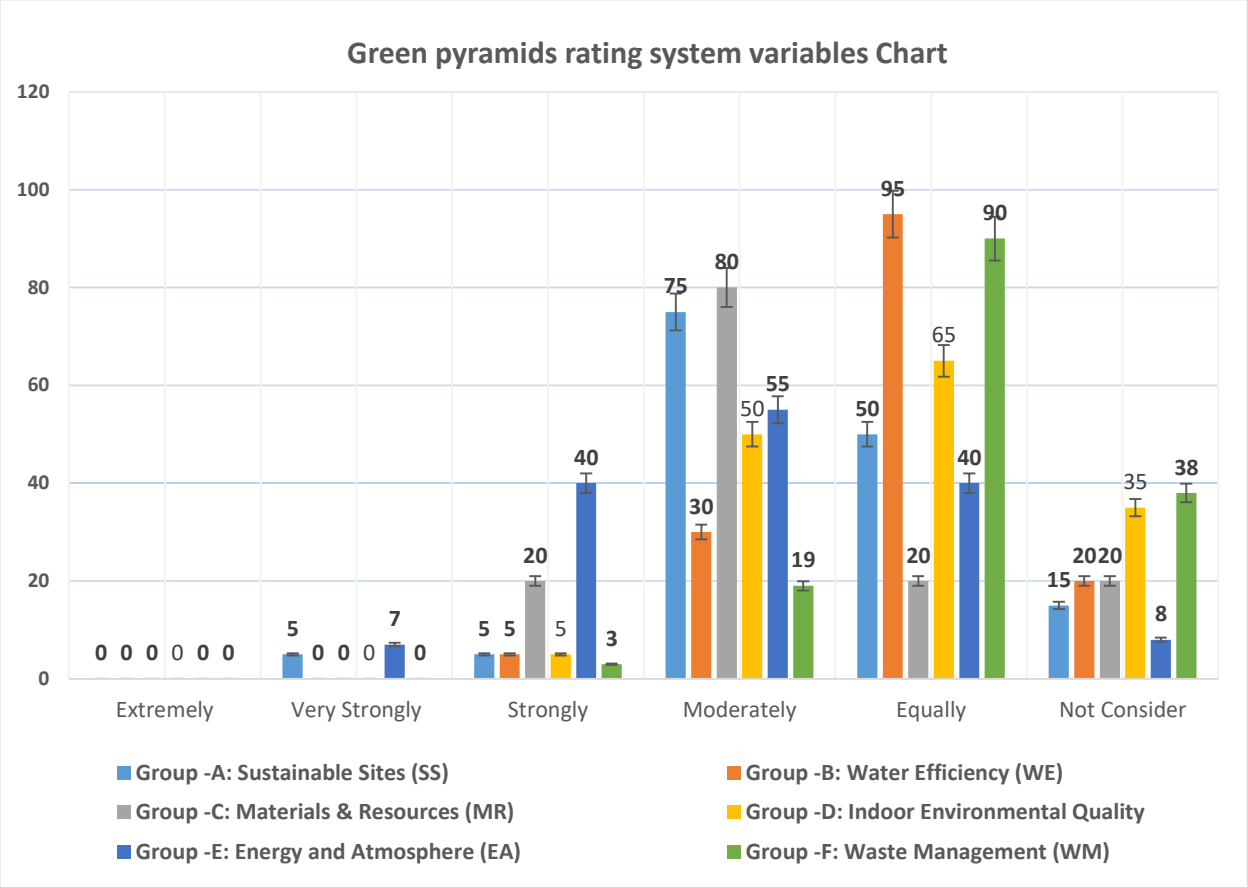


Fig 22. Chart of participant's awareness towards the green pyramid system in the new capital city.

The graphs depict the views of the surveyed architects towards certain elements of the Green Pyramid, as well as their overall information about the Green Pyramid. It should be noted that the architects are well-versed in both international and local evaluation systems, and discussions about activating the Green Pyramid for local evaluation and building licensing were fruitful.

Based on the outcomes of the questionnaire, In terms of the ability to apply a workable water process, the new capital city's adaptation of the Energy and Atmosphere (EA) aspect based on the Green Pyramid scored the highest. This is due to the publicizing of the installation of three water lines from neighboring areas, in addition to the water treatment central station and recycling units in the artificial lakes. As for the architectural design and the urban fabric, it is traditional concerning the requirements of energy assessment.

Table 12 indicates that the Sustainable Sites and Waste Management aspects of the Green Pyramid are respectively the second and third most preferred aspects in the New Capital City. The Materials & Resources, Water Efficiency, and IEQ components are respectively the fourth and fifth most preferred aspects. In contrast, the Energy and Atmosphere component of the Green Pyramid is the most extensively explored feature in the new Capital City.

Based on previous Tables: It was discovered that there are some differences in the scope of the Green Pyramid rating system requirements and the architectural components in the new capital city. The relationship is as follows:

Sustainable Sites: This is the one section that doesn't cover it at all. It is one of the gaps in sustainable building design in the new capital. This is also supported by the findings of the SWOT analysis.

Energy Efficiency: In the Energy Efficiency section, there was a lack of coverage in the operations and maintenance section, with only a small number of known office buildings being covered. Whereas the energy-efficient appliances section and the renewable energy farm and devices are well covered.

In the Materials and Resources aspect: Based on communication with the implementing ager terials made on-site (MoS) are not covered in any modules taught by the Egyptian offices, whereas reuse (MUS) is covered in the environment and management modules.

6.5- Sustainable Smart Cities Ke egies and Solutions: The research aims to collaborate more sustainable and smart capital an based on the sustainable smart city methodology, to re tegies and solutions to make the capita and

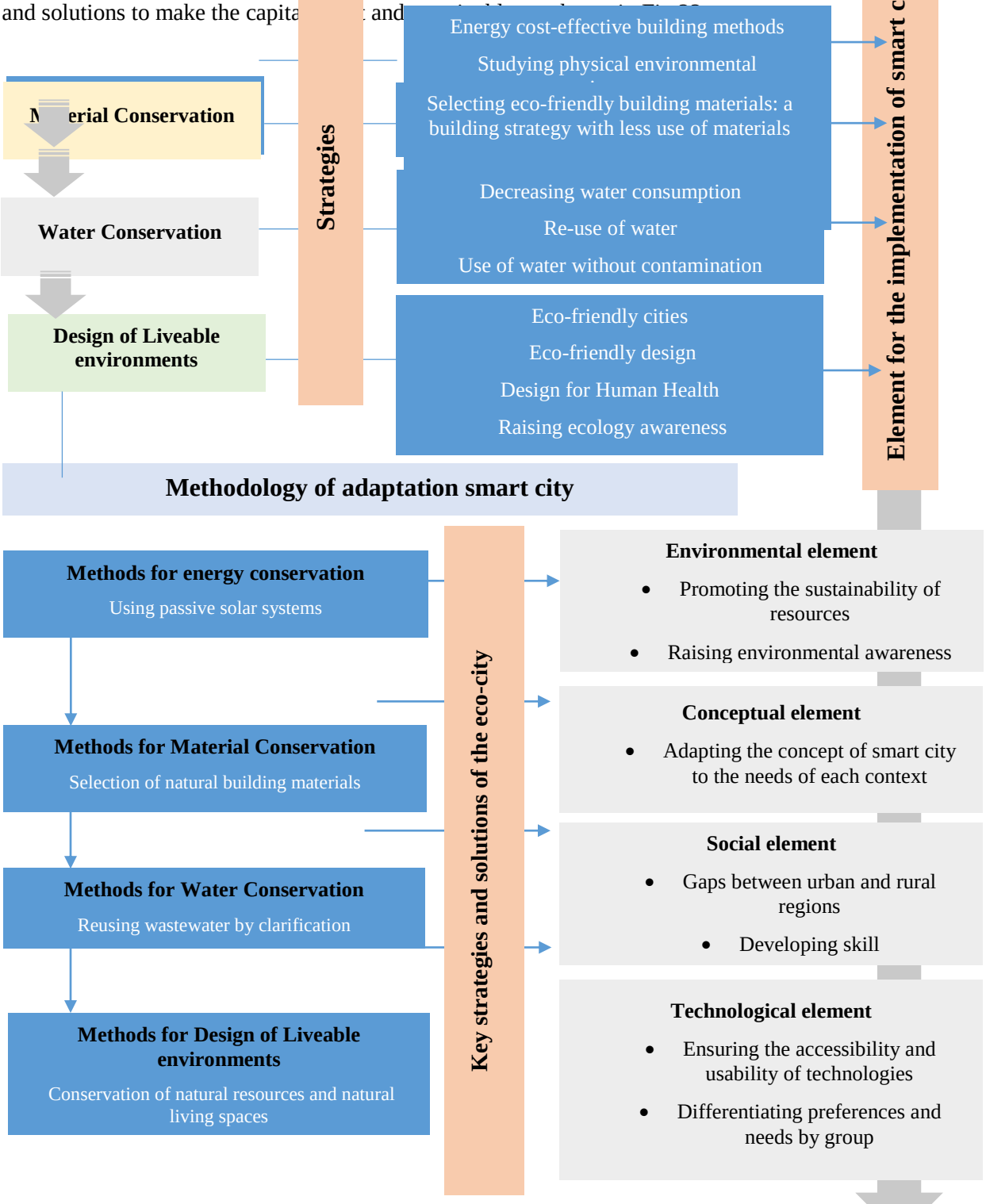


Fig 23. Sustainable Smart Cities Key Strategies and Solutions.

Conclusion

This research is relevant and important for the construction of new cities. Where As previously stated, adopting a sustainable smart city concept across the site helps protect the environment by reducing the escalation of hazardous gases and carbon emissions in Egypt.

The best location for an eco-city in Egypt is determined by factors such as solar energy, rainfall, soil type, vegetation, and population density. Finally, one viable approach is to reduce the emissions of the construction sector by converting standard buildings into green buildings that can adapt to the environment while at the same time preserving the health of users and occupants.

Sustainable smart cities are a practical concept that must be explored, and the seriousness with which they are implemented, as well as the selection of the most efficient area, is the basis and essence of sustainability. In this study, principles are discussed in terms of definitions, standards, and implications.

According to the results, this methodology should consider not only smart city components but also several problems. Informants reported that economic, technological, environmental, and conceptual barriers are critical to the success of such an approach.

The new capital can still achieve many of the characteristics of an "eco-friendly" in the future, and create a low-carbon path that complements those of other cities with ambitious goals to reduce carbon emissions.

Economic sustainability is a priority in the city's current goals, and the city's latest master plan aligns with key environmental sustainability features, which are particularly important for an innovative, high-income small city model. Finally, there is still potential for the new administrative capital to become a model for an eco-city that attracts investments.

If the city works as planned, it will highlight the necessity of integrating city planning, passive design, energy supply, transportation, water, and recycling activities to achieve a low-carbon society. However, there will be hurdles and barriers along the city road.

The environment and sustainability have received the attention of several other cities around the world. This study deals with identifying the challenges and development of cooperation to reach the foundations of smart environmental sustainability.

The New Capital concept is a new model for cities in Egypt. It recognizes many aspects of planning, including sustainable design, urban identity, and economic growth. The Egyptian government understands that all cities (including the list) must be sustainable.

The Ministry of Planning has adopted a new approach to planning new cities, with sustainability as a primary focus rather than a secondary objective. It anticipates the necessary steps to reach this goal, but within a clear framework, in line with the comprehensive national sustainability goals set out in Egypt's Vision 2030.

Architects, academics, and policymakers must collaborate and participate to transform cities into smart, environmentally friendly communities. All can identify actual problems and develop solutions by adapting current capabilities and taking into account the global economy

Also, the lack of a transportation network that facilitates movement to and from the Administrative Capital is an obstacle for some businessmen. However, the Egyptian government is currently implementing a strong transportation network that connects the capital with different regions such as Nasr City, Heliopolis, and others, such as the one-rail project.

When it comes to green communities, Egypt faces a significant challenge. Climate change and sustainability are becoming increasingly important issues around the world. Unfortunately, in Egypt and many other developing countries, there is no application in the field of green communities. In this regard, the current study lacks several topics and pieces of information on the new capital that have not been addressed.

Topics include green building policies and numerical methods for evaluating green ratings, while these studies indicate the direction of connecting the New Capital to the Green Pyramid rating system to be a sustainable city. It is recommended that the green pyramid classification for construction operations and permits be activated and developed.

The project is under construction despite all these arguments. It may also be difficult to know the correct point of view, or whether or not the new administrative capital will achieve its goals. It usually takes decades to see if an urban development project is successful or not, especially when it is a new capital city.

References

[1] Bakıcı, T., Almirall, E., & Wareham, J. (2013). A smart city initiative: the case of Barcelona. Journal of the knowledge economy, 4, 135-148.

[2] Attaran, H., Kheibari, N., & Bahrepour, D. (2022). Toward integrated smart city: A new model for implementation and design challenges. GeoJournal, 87(Suppl 4), 511-526.
[3] Patrão, C., Moura, P., & Almeida, A. T. D. (2020). Review of smart city assessment tools. Smart Cities, 3(4), 1117-1132.

[4] EIB, U. (2017). Assessment methodology for smart city projects–application to the Mediterranean region (ASCIMER).

[5] Nora Buletti. (2011). An analysis of Masdar City's communication strategy Using speech act theory to go beyond the corporate façade. University of Friburg, Faculty of Science, Geosciences Department.

[6] Farag, S. G. (2019, January). Application of smart structural system for smart sustainable cities. In 2019 4th MEC International Conference on Big Data and Smart City (ICBDSC) (pp. 1-5). IEEE.

[7] Lund, H. (2014). Renewable energy systems: a smart energy systems approach to the choice and modeling of 100% renewable solutions. 2nd ed., Academic Press, Burlington, USA.
[8] Catarinucci, L., De Donno, D., Mainetti, L., Palano, L., Patrono, L., Stefanizzi, M. L., & Tarricone, L. (2015). An IoT-aware architecture for smart healthcare systems. IEEE Internet of things journal, 2(6), 515-526.
[9] Abd El-Hameed, A., Mansour, Y., & Faggal, A. A. (2017). Challenges and issues for affordable housing in Egypt: A review. Engineering Research Journal.
[10] Ministry of Housing, Utilities, and Urban Communities (MHUC) represented by the General Organization for Physical Planning (GOPP), and any unauthorized use or distribution thereof will be subject to legal action.
[11] Nasreldin, R., & Abdelfattah, D. (2020). Toward Biophilic Egyptian Cities. The Case of New Administrative Capital in Egypt. *Journal of Urban Research*, *35*(1), 121-136.
[12] Loewert, P., & Steiner, C. (2019). The new administrative Capital in Egypt: The political economy of the Production of urban spaces in Cairo. *Middle East-topics & arguments*, *12*, 66-75.
[13] Kassab, Beesan, 'The new administrative capital: Outside the state budget or outside public accountability?', Mada Masr, 25 May2019https://madamirror12.appspot.com/madamasr.com/en/2019/05/25/feature/economy/thenew-administrative-capital outside-the-state-budget-or-outside.
[14] Hassan, E. H. M. A. (2022). The New Administrative Capital of Egypt (Wedian City) (Doctoral dissertation, POLITECNICO DI TORINO).
[15] Bolleter, J., & Cameron, R. (2021). A critical landscape and urban design analysis of Egypt's new Administrative Capital City. *Journal of Landscape Architecture*, *16*(1), 8-19.
[16] Abdeldayem, W. S., & El-Khouly, T. A. M. I. R. (2019). A macroscopic view of water management of the new administrative capital city of Egypt. In *Proceedings of the 12th space syntax symposium, Beijing, China*.
[17] Ghalib, H., El-Khorazaty, M. T., & Serag, Y. (2021). New capital cities as tools of development and nation-building: Review of Astana and Egypt's new administrative capital city. *Ain Shams Engineering Journal*, *12*(3), 3405-3409.
[18] Cube consultants, https://cubeconsultants.org/home/Cairo capital/ (Accessed 20/5/2022).
[19] Elmouelhi, H. (2019). New administrative capital—Cairo. Power, urban development and social injustice—The Official Egyptian Model of Neoliberalism. *Neoliberale Urbanisierung Stadtentwicklun*, 215-254.
[20] Serag, Y. (2017). The new administrative capital of Egypt is a critical review from the regional perspective. In The 1st International Conference: Towards a Better Quality of Life, Technische Universität Berlin Campus El Gouna Egypt (pp. 24-26).

[21] Hussein, A. A. A., & Pollock, E. (2019, August). Sustainable Development Approaches in Egypt. In *IOP Conference Series: Earth and Environmental Science* (Vol. 297, No. 1, p. 012027). IOP Publishing.
[22] Bakir, K., El-dek, M., & Khedr, A. (2022, December). Green Building Information Modelling to Raise the Efficiency of a Residential Building in the New Administrative Capital. In *IOP Conference Series: Earth and* Environmental Science (Vol. 1113, No. 1, p. 012002). IOP Publishing.
[23] Asdrubali F, Baldinelli G, Bianchi F, Sambuco S. A comparison between environmental sustainability rating systems LEED and ITACA for residential buildings. Build Environ 2015; 86:98–108
[24] Giama, E., and A. Papadopoulos. 2009. Rating systems for counting buildings' environmental performance. International Journal of Sustainable Energy 28 (1): 29-43.