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A Comprehensive Model to Assess Sustainable Architecture in Emerged Megacities: A Closer Look at Cairo's New Administrative Capital (NAC)

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Abstract: The concept of sustainable architecture plays a pivotal role in developing prosperous and environmentally friendly cities. The New Administrative Capital, as depicted in state media, incorporates many sustainable design elements. This includes the use of environmentally friendly building materials, energy-efficient infrastructure, water conservation and recycling, waste reduction, and the provision of green spaces along with efficient public transportation networks. The successful integration of these sustainable features within the NAC highlights the positive outcomes that can be achieved through sustainable urban architecture in major cities. These results not only reduce the environmental footprint but also improve the quality of life and provide economic benefits. However, to encourage the widespread adoption of sustainable urban architecture practices in major cities, further research, policy adjustments, and community engagement are essential. Therefore, this paper aims to present a framework specifically designed to evaluate sustainable initiatives within the New Administrative Capital of Cairo, focusing on its government district and examining the environmental, economic, and societal dimensions. This study will use a qualitative descriptive case study design complemented by a content analysis method.

Keywords: emerged megacities; sustainability; new capitals; assessment model



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1. Introduction

The concept of sustainable architecture within megacities has garnered widespread interest among researchers, policymakers, and citizens on a global scale. As our planet's population increasingly gravitates toward urban living, megacities, defined by populations exceeding ten million inhabitants, confront substantial challenges stemming from rapid urbanization, industrialization, and environmental degradation. Consequently, sustainable architecture emerges as a promising solution to ameliorate the adverse impacts of urbanization and industrialization [1]. Sustainable architecture encompasses the design and construction of buildings and urban spaces that champion environmental conservation, social equity, economic development, and human welfare. This approach typically involves harnessing renewable energy sources, implementing energy-efficient building systems, employing sustainable materials, and adopting strategies to minimize waste, conserve water, and promote public health. An intriguing and pertinent case study for the exploration of sustainable architecture within megacities is the New Administrative Capital (NAC) located in Cairo, Egypt. The NAC embodies a substantial investment by the Egyptian government, with the aim of establishing a modern, sustainable administrative hub that

nurtures economic development and effective urban planning. Notably, the NAC has been meticulously designed to incorporate various sustainable architectural elements, including green spaces, energy-efficient structures, and renewable energy sources, all contributing to the promotion of sustainability and the mitigation of the environmental repercussions of rapid urban expansion. This paper seeks to delve into the realm of sustainable architecture within megacities by employing the NAC in Cairo as a compelling case study. It will detail the sustainable architectural facets characterizing the NAC, scrutinize the challenges and prospects associated with sustainable architecture in megacities, and furnish insights into the potential for replicating and enhancing sustainable architectural practices in other megacities worldwide.

2. Methodology

This paper adopts a mixed methods approach, integrating qualitative and quantitative research methodologies to develop a comprehensive model that addresses the environmental, social, and economic dimensions of sustainability in architectural practices within emerging megacities, a methodology best suited to a complex study grounded in theory and reality. The methodology begins with an extensive review of the literature, focusing on sustainable architecture in rapidly growing urban centers, aiming to identify key challenges and opportunities in this field. The research complements a policy review of Egyptian national policy on urban sustainability, providing critical insights into media discourse and comparing it with tangible outcomes. Various theoretical studies on sustainability are then synthesized to formulate a comprehensive model for assessing architectural sustainability in specific urban areas within major emerging cities. To validate this model, data were collected through field visits, including interviews with engineering offices involved in the design and implementation of the Government Quarter, the first area completed on the ground in the New Administrative Capital of Cairo (NAC). The New Administrative Capital Company's policy regarding sustainability was examined, about which surprisingly little information is available. Finally, sustainability practices in the government district of the capital were evaluated at the levels of architecture, economy, and society to clarify the extent of their achievement, and recommendations were proposed to expand the scope of the model evaluation to include other regions within the New Administrative Capital, with the aim of promoting sustainable architectural practices in major cities and thus contributing to the advancement of sustainable development goals within the built environment. This analysis, although theoretical, provided the scientific basis for a detailed analysis of the different urban neighborhoods within the New Administrative Capital, specifically with regard to architectural sustainability.

3. Previous Related Studies

- In 2015, Stone and Marans analyzed a Michigan, USA community that was designed with sustainability in mind. Their study provides insights into urban design, detailing how ecological principles shaped the community. It explores green infrastructure, sustainable transportation, and social dynamics, emphasizing the importance of a collaborative approach for eco-friendly, socially thriving cities [2].
- The study titled *"Sustainable Development in Megacities"* aimed to integrate sustainable principles into megacity planning to address future challenges. It emphasized the importance of mitigating potential hazards and outlined frameworks for enhancing sustainability in urban areas. However, the study recognized that sustainability is a multifaceted issue and stressed the need to consider various dimensions in megacity planning. Despite this, it did not propose a specific method for evaluating sustainability in major cities [3].
- In 2019, a paper titled *"Sustainable Architecture for Future High Density Cities: An Applied Design Approach"* presented speculative architectural proposals for Shanghai and Hong Kong. Each project addresses urban challenges and incorporates innovative ideas from architectural and technological perspectives. The designs feature mid-rise

buildings with sustainable approaches, covering social and material aspects. The findings affirm that addressing social, ecological, and economic issues is crucial for sustainable architectural design [4].

- Yehia Serag discusses three viewpoints regarding the New Administrative Capital: support for economic growth, concerns about security and efficiency, and rejection due to investment priorities. Many participants in the study expressed concerns about the project's feasibility and impact, yet the study did not examine any projects within the capital [5]. While previous studies sparked discussions about sustainability issues in emerging capitals and major cities, they were limited in scope and lacked a focus on establishing an evaluation model for sustainability practices within these urban areas. This paper aims to address this gap by developing a comprehensive and effective evaluation framework.

4. New Cities as a Global and Egyptian Trend: Exclusiveness and Gated Communities (Historical Investigation)

The idea of building “satellite cities in the desert” was proposed in Cairo’s master plans from the 1950s. However, significant momentum towards desert development came after the 1973 war and the “Infitah” policy. Sadat’s 1974 “*Waraqat Uktubar*” emphasized developing Egypt’s “strategic vacuums” to reshape the nation’s map [6]. The 1974 paper emphasized the social purpose of desert expansion, but NUCA has consistently shifted away from this role, adopting the role of a real estate developer.

The first generation of new cities that surround Cairo was started in the 1970s [7]. Political motivations and urban expansion needs drove the decision to create new urban communities, influencing their naming. Two cities, the 6th of October City to the west—shown in Figure 1—and the 10th of Ramadan City to the east of Cairo, were named after the 1973 Egypt–Israeli war. The 15th of May City to the south was named after Sadat’s “reform revolution”. Sadat City, intended as Egypt’s administrative capital, briefly housed the Ministry of Housing before being relocated. Planning for these cities emphasized functional segregation, with commercial and service activities limited to specific areas. Private developers have also been involved in desert land development, creating gated districts with various names [8].

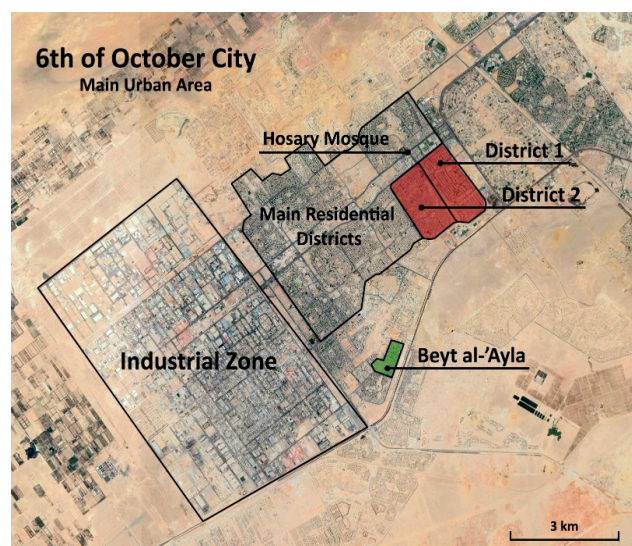


Figure 1. Satellite image of the main urban area of 6th of October City. Source: Google Earth. Edited by the authors.

5. Megacities: A Definition and Characteristics

Megacities, as defined by the United Nations (UN), are urban areas inhabited by no less than 10 million individuals [9], as shown in Figure 2. This term has gained prominence

due to the rapid urbanization witnessed over the past century. Tokyo, recognized as the first megacity, achieved this status in the 1970s [10]. Since then, numerous cities worldwide have attained this demographic milestone. The definition of megacity is obviously subjective because how a population is concentrated has the final say in distinguishing megacities from other urban areas, which are subjected to variations at different times. While Ancient Rome was a megacity with over one million in its population, London or Chicago, nowadays, can be considered megacities, although they fall below the ten million UN threshold [11]. Megacities are a result of the continuing urbanization. A megacity is typically distinct as a municipal zone with an entire population of over 10 million people. Megacities may be recognized from global cities by their swift development, novel forms of spatial population density, and both formal and informal economies, in addition to poverty, crime, and high levels of social disintegration. A megacity can be a solitary urban zone or two or more metropolitan zones that come together [12]. They represent a unique spatial form with strong internal coherence. Their activities and functions are closely interconnected within their boundaries, forming a singular entity despite diverse cultural and social backgrounds. Despite their vast territory, they function as cohesive units, with numerous individuals consistently utilizing the city's space [13]. Forecasts indicate that the expansion of megacities will persist. The UN anticipates the existence of 43 such cities by 2030, with over half situated in Asia [14]. It is imperative for governments and policymakers to consider the complexities and potentials that megacities offer and formulate strategies that ensure sustainable and inclusive urban development.

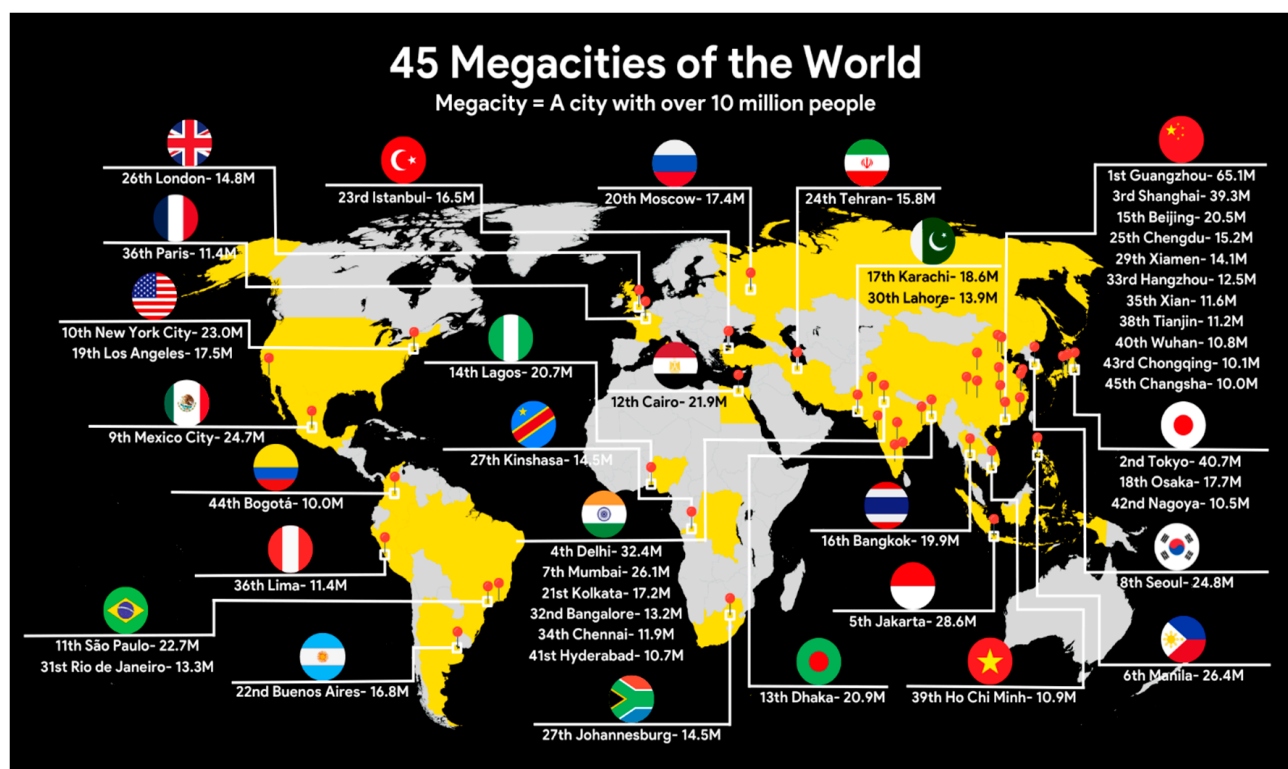


Figure 2. Megacities, as defined by the United Nations (UN), are urban areas inhabited by no less than 10 million individuals (UN, 2018). Source: https://www.reddit.com/r/dataisbeautiful/comments/113qqbq/the_45_megacities_of_the_world_oc/#lightbox (accessed on 4 July 2023).

6. Overview of the New Administrative Capital

In 2008, the Japanese International Cooperation Agency (JICA) published a paper titled “Strategic Urban Development Master-Plan Study for Sustainable Development of the Greater Cairo Region”. This study proposed three scenarios for the future growth of the Greater Cairo Region (GCR) and identified the third scenario as the most preferable, emphasizing

controlled urbanization and population growth, with a focus on directing people towards new urban communities on Cairo's periphery. This study supported existing policies regarding the planned development of Egypt's new cities. Within the GCR, there are eight cities, including 6th of October, 10th of Ramadan, 15th of May, Badr, Shaikh Zayid, Al-Shuruk, and New Cairo. Egypt's New Administrative Capital (NAC) is one of the new urban communities currently in development. According to national news reports, the NAC is projected to accommodate approximately 14.5 million residents across various residential zones, offering diverse housing options such as apartments, villas, and townhouses to cater to different income groups. The city is also expected to provide essential services and amenities, including educational institutions, healthcare facilities, recreational areas, and commercial zones. (See the NAC location, Figure 3).

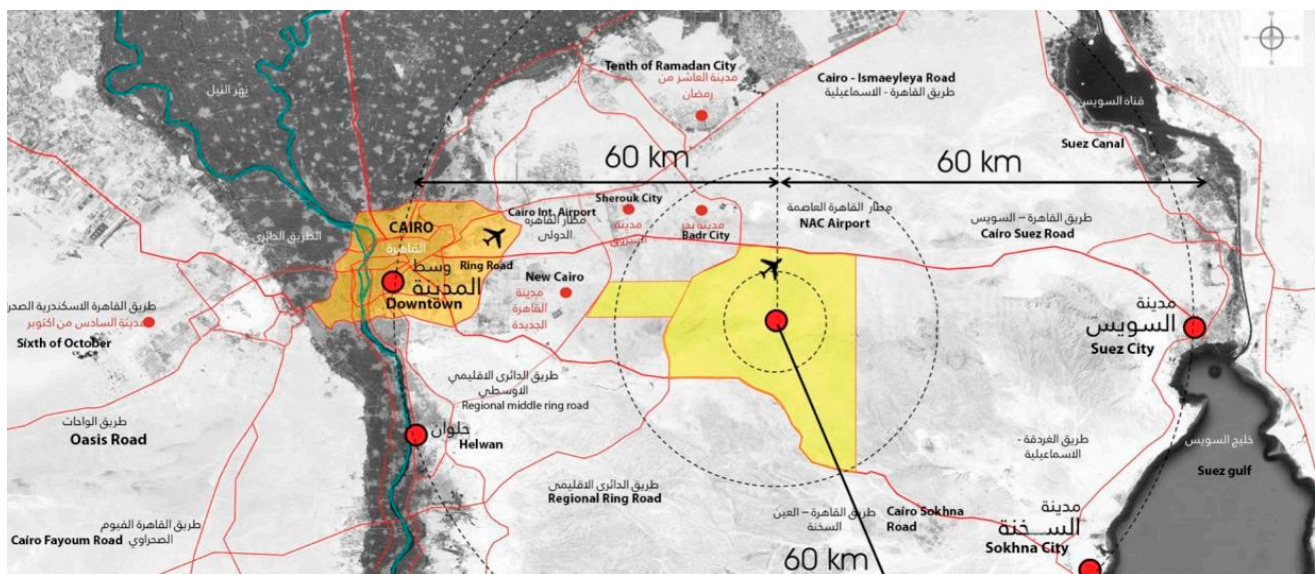


Figure 3. NAC location in the context of the Cairo region. Edited by the author. Source: The New Administrative Capital: The Egyptian case and the International experiences, Egypt today online, (2023). <https://www.egypttoday.com/Article/1/33872/Housing-min-named-acting-prime-minister> (accessed on 12 July 2023).

The New Administrative Capital (NAC) in Cairo, Egypt, was unveiled in March 2015 and is currently under development. Positioned as a sustainable megacity and Egypt's administrative hub, the NAC aims to span around 170,000 acres and house up to seven million residents. With an estimated cost exceeding USD 45 billion, funding is sourced from both the Egyptian government and private entities [15].

Capital relocations, like those seen in Brasilia, Astana, and Sejong, often involve moving the capital to a more central location within a country. Some researchers consider this move as a strategy to address community issues and promote nation-building, particularly in post-colonial nations [16]. The relocation commonly aims to symbolize a future of unified communities and modern statehood, enhancing a country's position within the international system. Typically, a capital city serves as the political, economic, and demographic center of the country, although sometimes it only holds political power. The separation of political and economic centers is evident in several countries, such as China (Beijing and Shanghai), the United States of America (Washington and New York), and Canada (Ottawa and Toronto) [17]. As a capital city grows with its political power well established, it attracts social, economic, and cultural momentum of national and international audiences. (Presented in Table 1 below).

Table 1. New capitals from 1960 till now. Source: New Capital Cities: A Timeless Mega-project of Intercontinental Presence (based on Nip, Kamiya M., edited by authors, 2023) <https://iopscience.iop.org/article/10.1088/1757-899X/960/2/022017/pdf> (accessed on 25 March 2024).

New Capitals Since 1960 Till Now			
2015	Cairo	NAC	Egypt
2011	-	Juba	South Sudan
2005	Rangoon	Naypyidaw	Myanmar
2005	Seoul	Sejong	South Korea
2001	Kuala Lumpur	Putrajaya	Malaysia
1997	Almaty	Astana	Kazakhstan
1983	Abidjan	Yamoussoukro	Ivory coast
1975	Lagos	Abuja	Nigeria
1973	Dar es salaam	Dodoma	Tanzania
1965		Zomba	Lilongwe Malawi
1964		-	Gaborone Botswana
1960		Rio De Janeiro	Brasilia Brazil
1959		Karachi	Islamabad Pakistan

Consequently, significant funds are required to provide adequate infrastructure for diverse activities and users, including education, culture, health, and trade. To realize this project, Skidmore, Owings, and Merrill (SOM) were engaged. They developed a master plan for the NAC, which took about two months to create a visual representation of the new city's design. Construction for the first phase of the NAC began in 2015, with the aim of accommodating up to seven million residents within a decade once all phases are completed [18]. (See master plan of NAC, shown in Figure 4).

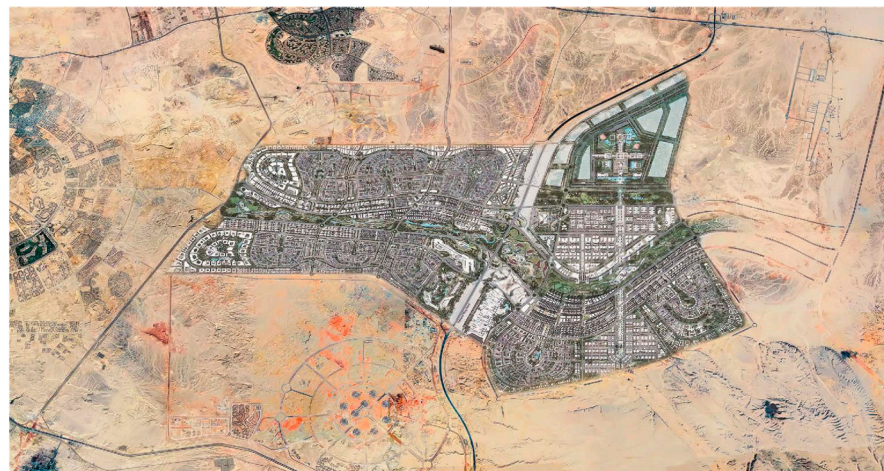


Figure 4. The NAC is intended to contain a governmental district, a central business district, an arts and culture district, an opera house, theaters and cinemas, and a sports city. The Phase One master plan is projected onto the existing desert site. Edited by the authors.

The new city is strategically located between Greater Cairo and the Suez Canal region, approximately 45 km east of Cairo, near the regional ring road and the Cairo-Suez road. The Minister of Housing explained the decision to place it there in December 2017, citing two primary reasons. Firstly, Cairo's expansion has been predominantly towards the east. Secondly, the location serves as a midpoint between Cairo and the rapidly developing Suez

Canal region, attracting substantial national investment. However, an opposing viewpoint is highlighted by Serag [5].

Some critics argue that the proximity of the new city to Cairo may contribute to urban sprawl, suggesting that it should be at least 500 km away to discourage daily commuting. This measure is aimed at preventing the new city from becoming deserted at night. The New Administrative Capital (NAC) aims to distance itself from previously failed New Town developments and instead position itself as a “world-class, global city” to attract investment and cater to the growing middle class. Egyptian Prime Minister Sherif Ismail expressed optimism that the new city would alleviate Cairo’s overcrowding and traffic congestion, emphasizing the need for unconventional solutions to such issues [19]. From a governmental point of view, the New Administrative Capital represents an image of what modern cities should be like. (See Figures 5–7).



Figure 5. Green River Park, also referred to as Capital Park, is set to be a river-like series of large-scale urban parks located in the New Administrative Capital of Egypt. Source: “The construction of the 35-km Green River in the Egyptian New Administrative capital” <https://worldarchitecture.org/> (accessed on 24 August 2023).



Figure 6. Green River Park, also referred to as Capital Park, is set to be a river-like series of large-scale urban parks located in (NAC). Source: <https://worldarchitecture.org/> (accessed on 24 August 2023).

Several fundamental features and sustainability objectives distinguish the NAC as it pertains to sustainable architecture and holistic development. Notably, the NAC places a strong emphasis on harnessing renewable energy sources like solar and wind power, with the aim of reducing dependence on non-renewable energy resources. Additionally, the NAC actively encourages the utilization of public transportation, including trains, buses, and taxis, as a means to alleviate reliance on personal vehicles and curtail air pollution [20]. Another pivotal facet of the NAC’s design is its focus on verdant spaces and landscaping.

The incorporation of numerous parks, gardens, and trees is envisioned to enhance the air quality and promote public health. Furthermore, the NAC considers access to public spaces a fundamental requirement for an improved quality of life [21]. But, by monitoring the reality and the projects that have been completed and those that are in the process of implementation, it is noticeable that the interest lies in giving priority to the formal aspect over the aspects of sustainability and compatibility with the surrounding context. (See Figure 8, which includes a variety of projects in the New Administrative Capital).



Figure 7. Central Business District (CBD) in the New Administrative Capital of Egypt. Source: “PROJECTS: Egypt’s Arqa Developments launches Phase 2 of I-Business park” <https://www.zawya.com/en/projects/projects-egypts-arqa-developments-launches-phase-2-of-i-business-park-akt9j8xn> (accessed on 20 August 2021).

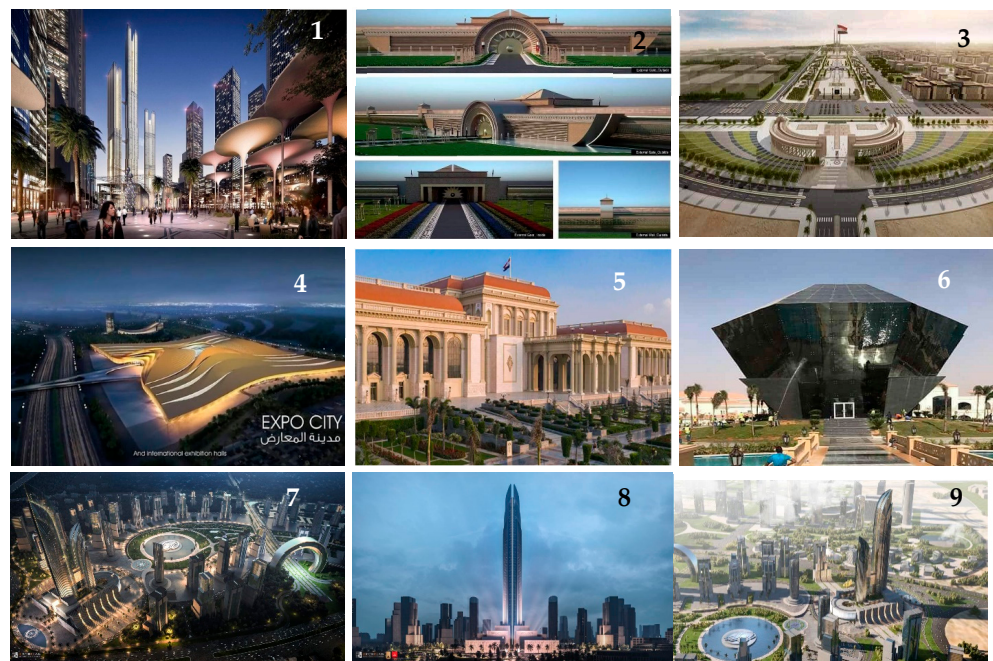


Figure 8. Urban and architecture morphology “seems like dream city”: No. 1: Downtown of business district; No. 2: Presidential palace in front of “Egypt Mosque”; No. 3 “The peoples’ square”; No. 4: The ornate exterior design of Expo city”; No. 5 “the new Opera”; No. 6 “Al-Massa Military Hotel”; No. 7,9 “New media city”; No. 8: The nut tower in new media city. Source: (5+ UDC office).

7. Eco, Social, and Economic Dimensions of Architectural Sustainability

Recognized as the world’s major cause of environmental degradation and pollution, the construction industry has been criticized for depleting natural and non-renewable resources, leading to adverse effects, including global warming and climate change [22]. Sustainable architecture aims to minimize the environmental impact of buildings while

considering the social and economic factors, achieving a balance among these dimensions. The ecological dimension focuses on the environmental impact of architecture and its relationship with the natural environment. Architects and engineers must prioritize reducing energy consumption, carbon footprints, waste generation, and water usage in their building designs to minimize the ecological footprint. Utilizing environmentally friendly materials and integrating green infrastructure technologies are effective, sustainable practices that can lower energy use and greenhouse gas emissions, thus promoting a sustainable built environment [23]. The social dimension is the second major dimension of architectural sustainability and emphasizes the effect of architecture on human well-being, health, and social equity. This dimension calls for the creation of spaces that are responsive to human needs and that create a sense of place in the community. Architects must consider design principles that promote accessibility, inclusivity, and satisfaction while fostering a connection with nature by incorporating natural elements into their designs. This helps to promote social sustainability while creating a strong sense of community and belonging. Additionally, urban green spaces, such as parks and green roofs, can promote social cohesion, improve mental health, and enhance urban biodiversity [24].

The economic dimension is crucial in sustainable design, covering the financial feasibility of sustainable architecture, including design and construction costs, as well as lifetime building costs, including operation and maintenance. Investing in sustainable building materials and systems reduces long-term costs by lowering energy consumption, improving maintenance efficiency, and reducing repair expenses over the building's lifespan. A sustainable design also fosters economic development by generating job opportunities in constructing and maintaining sustainable infrastructure (Giuliano et al., 2018) [25]. Hence, the ecological, social, and economic dimensions of architectural sustainability are interconnected pillars that must be considered together in creating a sustainable built environment. Sustainable measures that reduce the environmental impact of architecture, promote social equity, and ensure economic viability, thus create a sustainable built environment that benefits the environment, society, and future economic stability.

8. Key Aspects of Sustainable Architecture in Megacities

As the global population urbanizes at a rapid pace, the importance of sustainable architecture grows exponentially. In this context, grasping the key facets of sustainable architecture in megacities becomes paramount for tackling the distinctive challenges and opportunities they offer. This section delves into the crucial dimensions of sustainable architecture in major urban centers, shedding light on their significance and impact on urban sustainability.

- **Strategic Site Selection**

This process involves identifying suitable locations for construction projects, taking into account factors like accessibility to public transportation, the availability of renewable energy sources, and proximity to vital public facilities such as schools and hospitals. In the context of megacities, where open spaces may be limited, sustainable urban planning principles play a crucial role in pinpointing areas for green spaces and other sustainable infrastructure. Examples of such principles include the compact city model, which advocates for increased urban densities, mixed-use developments, and the promotion of active transportation and public transit [26]. Another approach is the green urbanism model, which strives to strike a balance between environmental sustainability, social equity, and economic viability [27].

- **Energy Efficiency**

Energy efficiency is a cornerstone of sustainable architecture. This facet entails strategies designed to curtail energy consumption in buildings, leading to substantial cost savings on energy bills and a reduction in carbon emissions. Energy efficiency tactics encompass passive solar design, meticulous building orientation, and the optimization of daylighting. Additionally, the integration of intelligent building control systems, responsible for manag-

ing heating, ventilation, and air conditioning (HVAC) systems, stands as an effective means to reduce energy consumption while maintaining indoor air quality [28]. The incorporation of renewable energy sources such as solar, wind, and geothermal systems serves to diminish reliance on non-renewable energy sources [29].

- **Water Conservation**

Water conservation holds a pivotal position in sustainable architecture. In regions grappling with water scarcity, like many megacities, water conservation strategies prove indispensable for ensuring water security. These strategies entail the installation of water-efficient fixtures, the practice of rainwater harvesting, and the recycling of greywater. Additionally, xeric landscaping, which involves the utilization of plant species adapted to arid conditions, necessitating minimal water and maintenance, emerges as a valuable approach [30]. Innovative water conservation strategies, such as the reverse osmosis desalination processes for water treatment and the deployment of efficient irrigation systems, have been adopted in cities like Singapore and Barcelona [31].

- **Sustainable Transportation**

Sustainable transportation constitutes another pivotal facet of sustainable architecture within megacities. The promotion of public transportation usage serves to reduce the volume of personal vehicles on the road, thereby yielding benefits such as reduced carbon emissions, alleviated traffic congestion, and diminished air pollution. Furthermore, investments in infrastructure that encourage walking and cycling, including the development of sidewalks, bike lanes, and pedestrian crossings, foster active transportation and diminish reliance on automobiles. Success stories in this realm are evident in cities like Copenhagen and Amsterdam, where sustainable transportation models have been effectively implemented, with over 60% of residents commuting by bike or on foot [32].

- **Social Equity**

Social equity constitutes an integral component of sustainable architecture. Strategies within this domain strive to ensure access to affordable housing, healthcare, education, and public amenities for all residents, thereby fostering social cohesion. Sustainable building designs also take into account the needs of vulnerable populations, including children, the elderly, and individuals with disabilities. Incorporating indoor environmental quality (IEQ) strategies, such as efficient ventilation systems, access to natural light, and the use of non-polluting materials, can have a positive impact on health outcomes and significantly enhance the quality of life for residents [33]. The subsequent section of the paper will delve into the aspects of assessing the sustainability of megacities:

- **Environmental Metrics:** Monitoring the air and water quality, waste management practices, and energy consumption patterns to mitigate environmental degradation and reduce carbon footprints.
- **Social Indicators:** Tracking quality of life, equity, and public health by assessing factors such as education, access to healthcare, and income distribution to ensure inclusive and resilient urban development.
- **Economic Performance:** Assessing GDP growth, employment opportunities, and innovation capacity to enhance economic vitality and diversification.
- **Infrastructure and Urban Planning:** Considering transportation efficiency, availability of green spaces, and housing affordability to enhance livability and accessibility for all residents.
- **Resilience and Adaptation Measures:** Focusing on climate resilience, disaster preparedness, and infrastructure resilience to mitigate risks and enhance city-level resilience to natural hazards.
- **Sustainable Architectural Practices:** Implementing sustainable practices at the architectural design level, such as building around internal courtyards or utilizing double-wall techniques and facades with energy-producing capabilities like solar panels.

- **Culture and Heritage Preservation:** Protecting cultural identity, promoting creative industries, and enhancing the city's overall cultural vitality through efforts to preserve culture and heritage.

9. Challenges and Opportunities for Sustainable Architecture in Megacities

- **Challenges**

The expansion of megacities ushers in notable environmental and social concerns, such as heightened pollution, traffic congestion, social inequality, and public health issues. Sustainable architecture emerges as a potent means to address these challenges and forge more habitable and resilient urban landscapes. Nevertheless, implementing sustainable architectural practices in megacities brings forth an array of potential obstacles as well as opportunities and benefits.

- **Cost as an Obstacle**

The financial barrier presents a significant impediment to the adoption of sustainable architecture in megacities. The substantial upfront investment needed for sustainable initiatives, like energy-efficient building strategies, dissuades developers due to the elevated costs of materials and technologies. Additionally, the prevailing regulatory framework often overlooks sustainability, compounding the reluctance to invest in green technologies. Immediate action is essential to surmount these financial challenges and propel a shift towards sustainable architecture in urban areas [34].

In addition, a notable challenge exists within the domain of public awareness and advocacy for sustainable architecture. The degree of public awareness holds considerable sway over the decisions made by developers and policymakers, influencing them to prioritize sustainable architectural approaches. Nevertheless, the lack of widespread understanding and support for the advantages of sustainable architecture impedes investments in eco-friendly infrastructure and technologies. This knowledge gap underscores the importance of educational initiatives and community engagement efforts to foster a greater awareness and appreciation for sustainable architectural practices, ultimately paving the way for increased investment and adoption in megacities [35].

- **Opportunities and Benefits**

Despite these challenges, there exists a multitude of opportunities and advantages linked to the adoption of sustainable architecture within megacities.

- **Enhanced Quality of Life**

Foremost among these opportunities is the prospect of a markedly improved quality of life for urban residents. Sustainable infrastructure, encompassing energy-efficient buildings, pedestrian and cyclist-friendly neighborhoods, and verdant spaces, has the capacity to elevate living conditions. It can reduce noise pollution and contribute to an overall sense of well-being [36].

- **Economic Benefits**

Energy-efficient buildings can substantially cut energy costs for both businesses and residents, resulting in economic gains. Sustainable transportation options, including public transit systems, dedicated bike lanes, and pedestrian zones, not only diminish transportation expenditures but also foster healthier lifestyles. Additionally, sustainable architecture is instrumental in advancing environmental conservation, curbing greenhouse gas emissions, and bolstering urban economic resilience against the impacts of climate change [37].

- **Replication and Global Collaboration**

Moreover, sustainable architecture within megacities offers the potential for replication and improvement in cities worldwide. Valuable lessons gleaned from innovative and successful projects in one urban center can be thoughtfully applied to others. This approach

can lead to reductions in costs, reforms in policies, and enhanced global collaboration in the quest for innovative solutions to the challenges of urban sustainability [38]. Consequently, while the integration of sustainable architecture within megacities poses potential obstacles, including costs, regulatory hurdles, and limited public awareness, it presents numerous opportunities. These opportunities encompass an enhanced quality of life, economic benefits, diminished environmental impact, and the potential for global replication and improvement in other megacities around the world.

10. Sustainable Architecture Features in the New Administrative Capital (NAC)

Researchers and society have a wide range of opinions when it comes to assessing whether the New Administrative Capital is genuinely committed to sustainable practices in its architecture and planning. Some folks are pretty critical and do not hold back in expressing their concerns. They argue that sustainable considerations seem to be lacking throughout the planning and execution phases of the project, and they are particularly vocal about the absence of eco-friendly practices. They are basically saying that more needs to be done in this department.

On the flip side, there are those who take a more optimistic view. They believe that the New Administrative Capital is actually leading the way when it comes to incorporating sustainability into its development. They argue that certain aspects of the project align with eco-friendly goals and show a dedication to balancing modernization with environmental responsibility. The next part will deal deeply with these arguments:

- **Optimistic Perspective**

The New Administrative Capital (NAC) in Egypt has made a significant commitment to sustainability by integrating sustainable practices into its facilities [39]. This includes the construction of sustainable schools and community centers within the city's urban fabric. The aim of these efforts is to promote and foster sustainable habits among its residents, encouraging them to adopt a more eco-friendly lifestyle. The NAC's sustainable architectural features serve as an exemplar of sustainable urbanization [40] and showcase the city's dedication to environmental responsibility. Through the implementation of green building strategies, the NAC demonstrates an understanding of the importance of preserving the natural environment while simultaneously creating a safe and healthy environment for its residents. According to a study by the *Journal of Architecture and Planning Research*, the integration of sustainable practices into the city's urban fabric creates a model for sustainable urbanization that can be emulated by other cities around the world [41]. The NAC serves as a compelling illustration of a city that prioritizes both environmental responsibility and social well-being, providing an excellent example of how sustainable urban planning can create a better future for everyone.

- **Water Conservation and Reclamation**

Water conservation and reclamation are integral facets of the NAC's sustainable architectural blueprint. The NAC encourages the implementation of xeric landscaping, which demands less water compared to conventional lawns and gardens. Moreover, it employs efficient irrigation and collection systems. Additionally, the NAC has invested in water treatment facilities designed to recycle wastewater for irrigation and other non-potable applications.

- **Public Transportation and Green Spaces**

The NAC places great emphasis on enhancing public transportation options and green spaces to decrease reliance on personal vehicles, enhance air quality, and promote public health. Several parks, including a sprawling central park spanning over ten kilometers, a botanical garden, and tree-lined streets and walkways, have been thoughtfully incorporated to encourage pedestrian and bicycle traffic.

Pessimistic Perspective

From a sustainability perspective, there are concerns about the New Administrative Capital (NAC) due to its potential harm to the environment. This sprawling city, spanning over 700 square kilometers, is being constructed in a region already facing water scarcity issues [42]. Critics worry that building the NAC in such an area could worsen the water depletion problems and strain the already limited water resources.

Furthermore, the construction of the NAC is displacing communities, which raises questions about fairness in society. Critics argue that marginalized groups, including farmers and informal laborers, who lose their land due to the NAC's development may not receive adequate compensation [24]. They contend that the focus on grand national projects like the NAC often comes at the expense of local communities, who bear the negative environmental and social consequences. Aside from the concerns related to its impact on society and the environment, there has also been extensive discourse about the cost of the New Administrative Capital (NAC). Estimates suggest that this endeavor is set to surpass USD 45 billion in expenses, with a substantial portion of the funding being sourced from Chinese investments [43]. This substantial price has given rise to questions regarding the project's economic feasibility, particularly when taking into account potential drawbacks for the environment and society. To alleviate some of these concerns, there have been proposals for the NAC to embrace the principles of sustainable architecture and urban design. Sustainable architecture places a significant focus on energy efficiency, the utilization of renewable resources, and the minimization of environmental harm [44].

By incorporating these sustainable design principles into the NAC's construction, there is an opportunity to diminish the city's environmental footprint and enhance its ability to withstand environmental challenges. One of the main issues people are debating about the New Administrative Capital (NAC) project is whether it is affordable for a significant number of Egyptians. Despite being promoted as a symbol of advancement and contemporary development, there is growing worry among many Egyptians that it might end up being too expensive for those with lower incomes.

Al-Monitor's reports have highlighted worries about the project's funding sources and who will reap the greatest benefits from it. The anticipated cost of living in the New Administrative Capital (NAC) is expected to be significantly higher than in other Egyptian cities due to the planned luxury apartments, upscale shopping districts, and exclusive private clubs. While the government asserts its commitment to providing affordable housing, doubts linger about whether these options will genuinely be within reach for the average Egyptian citizen (See Figure 9). A stronger point of criticism regarding the New Administrative Capital (NAC) project revolves around its lack of sustainable architectural solutions in its design. According to a report from The National in 2020, the project does not prioritize eco-friendly infrastructure. The report emphasizes that the NAC project neglects green building practices, which can effectively reduce energy consumption and water usage. Instead, the focus appears to be on creating a sense of grandeur and luxury without due consideration for the environmental impact and long-term sustainability of the city. Furthermore, as pointed out by Architizer in 2021, the NAC project has been criticized for not incorporating low-tech solutions that could enhance the energy efficiency of buildings, such as shading devices and passive cooling systems. These solutions have the potential to significantly reduce energy consumption and promote sustainability over time. Another concerning aspect is the project's impact on existing ecosystems and natural habitats, as reported by Al-Monitor in 2019. The NAC project has been accused of disrupting these environments without adequately reusing and recycling materials, raising valid concerns about its environmental footprint and long-term sustainability. The absence of sustainable architectural solutions in the NAC project is a major point of criticism. The project's focus on opulence rather than eco-friendliness could lead to environmental challenges down the road. Addressing these concerns and incorporating sustainable measures, such as green building practices and low-tech solutions, into the NAC's design is essential to mitigate its environmental impact. Accordingly, The New Administrative Capital has generated diverse

viewpoints regarding its sustainability. Some praise its eco-friendly initiatives like water conservation, public transportation, and green spaces, while others express reservations about its potential negative impacts on the environment and society and its substantial cost. Critics also stress the current absence of sustainable architectural solutions in the NAC, suggesting that this could lead to future environmental issues. Achieving a balance between socio-economic, cultural, and environmental factors during the development of new cities like the NAC is of utmost importance.



Figure 9. The NAC project is criticized for not incorporating low-tech solutions that could enhance the energy efficiency of buildings like Iconic Tower under construction. Source: Dar al-Handasah Shair and Partners.

11. A Comprehensive Model to Assess Sustainable Architecture in Emerged Megacities

In this section, the significance of sustainable architecture within burgeoning megacities is explored as a strategic response to the multifaceted challenges posed by rapid urbanization. It underscores the pivotal role of sustainable architectural principles in mitigating these challenges, which include the imperative to curtail the carbon footprint and optimize the utilization of our finite natural resources.

- **Benefits and Strategies of Sustainable Urban Development**

Green infrastructure can mitigate the urban heat island effect by reducing the surface temperature, thereby reducing the demand for air conditioning. Moreover, it can reduce the amount of stormwater runoff by absorbing and filtering rainwater, improving the hydrological cycle in the city. The use of sustainable public transport systems such as light rail or bike-share programs can provide affordable and sustainable mobility to the residents, reducing traffic congestion, greenhouse gas emissions, and air pollution. According to Lützkendorf et al. (2019), sustainable architecture can also stimulate local economic growth by attracting investments in sustainable infrastructure and acting as a catalyst for job creation in the construction and maintenance sectors [44].

The sustainable architectural approach advocated here is characterized by a commitment to leveraging renewable materials, integrating energy-efficient technologies, and integrating green spaces into the urban fabric. These measures collectively contribute to a holistic approach to urban development that prioritizes environmental stewardship.

- **Balancing Cultural Heritage with Sustainable Architecture in Megacities**

However, sustainable architecture in the context of these dynamic megacities confronts formidable obstacles. Foremost among these challenges is the delicate task of preserving cultural heritage while concurrently accommodating the relentless pace of urban life. Moreover, it aspires to champion social sustainability by fostering inclusivity, ensuring safety, nurturing social cohesion, and promoting active community engagement. Furthermore, the economic sustainability dimension of sustainable architecture underscores its potential to stimulate economic growth. This is achieved by harnessing renewable energy sources, prioritizing the use of sustainable building materials, and fostering a skilled labor force.

Importantly, it advocates for the equitable distribution of economic benefits arising from sustainable design, with due consideration given to social and economic equity factors.

- **The Role of Sustainable Architecture in Urban Development**

In the context of sustainable development, sustainable architecture stands as a crucial component, particularly in urban settings experiencing a heightened demand for housing, infrastructure, and amenities. By embracing sustainable architecture, it becomes possible to mitigate the harm inflicted on ecosystems, natural resources, and the environment as a result of extensive urban expansion. The benefits associated with sustainable architecture are manifold, encompassing a decrease in carbon emissions, as well as energy and water conservation, enhanced indoor environmental quality, and heightened occupant well-being and comfort [45].

- **The Essence and Impact of Green Buildings**

Green buildings represent a category of structures meticulously designed and constructed with the dual objectives of minimizing the environmental impact and providing a comfortable, healthful indoor environment. The essence of green buildings lies in the integration of sustainable design principles, construction methodologies, and energy- and water-efficient systems. These components function harmoniously to curtail energy usage, water consumption, waste generation, and greenhouse gas emissions [46].

- **Sustainability and Health Benefits of Green Buildings**

Green buildings harness innovative techniques such as daylight utilization, passive solar design, and energy-efficient HVAC systems to diminish energy consumption. Moreover, they incorporate sustainable materials, including recycled or locally sourced products and those emitting fewer volatile organic compounds (VOCs), thus reducing the environmental impact and safeguarding human health. At their core, green buildings prioritize the health and well-being of their occupants. Features like indoor vegetation, natural ventilation systems, and non-toxic building materials are woven into the fabric of green buildings, fostering improved indoor air quality, reduced noise pollution, and the creation of a healthier indoor milieu.

- **Creating Sustainable Cities: Principles and Priorities**

Sustainable cities constitute urban environments that embrace sustainable development principles to craft a more inclusive, resilient, and healthier setting. These cities zero in on the reduction of greenhouse gas emissions, the promotion of renewable energy adoption, and the nurturing of livable, green, and healthy urban spaces. Sustainable cities allocate considerable attention to sustainable infrastructure, robust public transportation networks, green areas, and the provision of affordable, energy-efficient housing [47].

Sustainable cities artfully integrate sustainable architecture and urban design principles to forge a sustainable milieu. Notable examples encompass sustainable transportation systems, exemplified by dedicated bike lanes, robust public transit systems, and carpooling services, as well as energy-efficient building practices and green zones. Sustainable cities diligently strive to trim resource consumption while championing the utilization of renewable energy sources, such as solar and wind power [48].

- **The Social Imperative of Sustainable Architecture in Megacities**

The social dimension of sustainable architecture in megacities is equally crucial in addressing social inequalities, promoting cultural diversity, and enhancing social inclusion. Sustainable architecture must be responsive to the specific cultural, societal, and economic contexts of the megacity, taking into account the needs and preferences of its diverse populations. Integrating green spaces and public spaces such as parks, community gardens, and plazas can provide residents with spaces to interact, connect, and engage in social activities, promoting social cohesion and public health. Additionally, designing public spaces that cater to people with disabilities or the elderly, such as ramps, elevators, and

noise-reducing infrastructure, can promote social equity, encourage social participation, and foster a sense of belonging among residents.

To lay a strong foundation for the architectural framework in megacities, it is imperative to undertake several key steps. These include promoting energy-efficient design practices, establishing efficient transportation systems, creating green spaces, and implementing policies that encourage the use of eco-friendly materials. In the subsequent sections, we will explore each of these critical steps in detail, emphasizing their importance in realizing the vision of sustainable architecture within the dynamic context of our megacities. By embracing and actively integrating these measures, we can reshape our urban environments into spaces that are not only more habitable but also better equipped to address challenges and safeguard the well-being of both current and future generations. The following points summarize the critical elements within the assessment model:

- **Ecological Dimension Assessment:**
 - **Materials and embodied carbon:** This includes evaluating the environmental impact of materials used in the construction, such as evaluating the embodied carbon, using renewable materials, and toxic chemical reduction.
 - **Biodiversity and ecology:** This includes assessing the impact of design on biodiversity and the ecological systems within the site.
 - **Carbon footprint:** This includes evaluating the carbon footprint across the life cycle of the building, including its construction, operation, and maintenance.
- **Social Dimension Assessment:**
 - **Community engagement:** This includes actively engaging with the local community in the design, planning, and implementation of sustainable architecture projects.
 - **Cultural diversity:** This includes assessing how the design promotes cultural diversity and celebrates the local culture of the area.
 - **Noise and acoustics:** This includes evaluating the design's impact on noise pollution and acoustic performance, which can affect occupants' mental and physical health.
- **Economic Dimension Assessment:**
 - **Social return on investment:** This includes assessing the broader benefits of the investment, such as reduced healthcare costs, increased worker productivity, and enhanced social welfare.
 - **Long-term sustainability:** This includes evaluating how the design contributes to long-term sustainability goals, such as reducing carbon emissions and promoting the circular economy.
 - **Smart technologies:** This includes the incorporation of smart technologies such as building information modeling (BIM), IoT, and artificial intelligence (AI) to reduce operating costs, enhance occupant comfort, and improve maintenance efficiency.

The research advocates for the development of a comprehensive assessment model for sustainable architecture in megacities (see Figure 10). Such a model should encompass various facets of sustainability, spanning three dimensions. By taking into account a wide array of factors, including materials, carbon footprint, community involvement, acoustics, and advanced technologies, designers, policymakers, and developers can guarantee that buildings and infrastructure achieve sustainability, foster social equity, and maintain economic feasibility. This, in turn, contributes to creating megacities that are not only more habitable but also better equipped to withstand challenges and benefit all residents. This model will apply to the governmental district in the NAC. The information has been collected from 5+ UDC (5+ UDC is a team of professionals that started on the 1st of January 2015 to provide investors with services, including city planning, rural planning, land-use modeling, tourism and coastal areas planning, industrial planning, community development and

upgrading, urban design, architecture, landscape architecture, interior design, structural and civil engineering, electromechanical (MEP) engineering, road engineering, presentation and modeling, project and construction management, and research and development. UDC also provides support for investors regarding bidding and post-commission processes, project planning and scheduling, site supervision, procurement and cost control, management of information systems, as well as programming) and ACUD (Administrative Capital For Urban Development (ACUD) is the owner and developer for the New Administrative capital in Egypt, which is located 35 KM east of Cairo, with a total area of 170,000 feddan. The new capital city will help to strengthen and diversify the country's economic potential by creating new places to live, work and visit. In order to draw people to this new capital city, a series of key catalyst developments will be established at its core. This will include a new government administrative district, a cultural district, and a wide variety of urban neighborhoods), and additionally, from site visits. (See the assessment and discussion in Table 2).

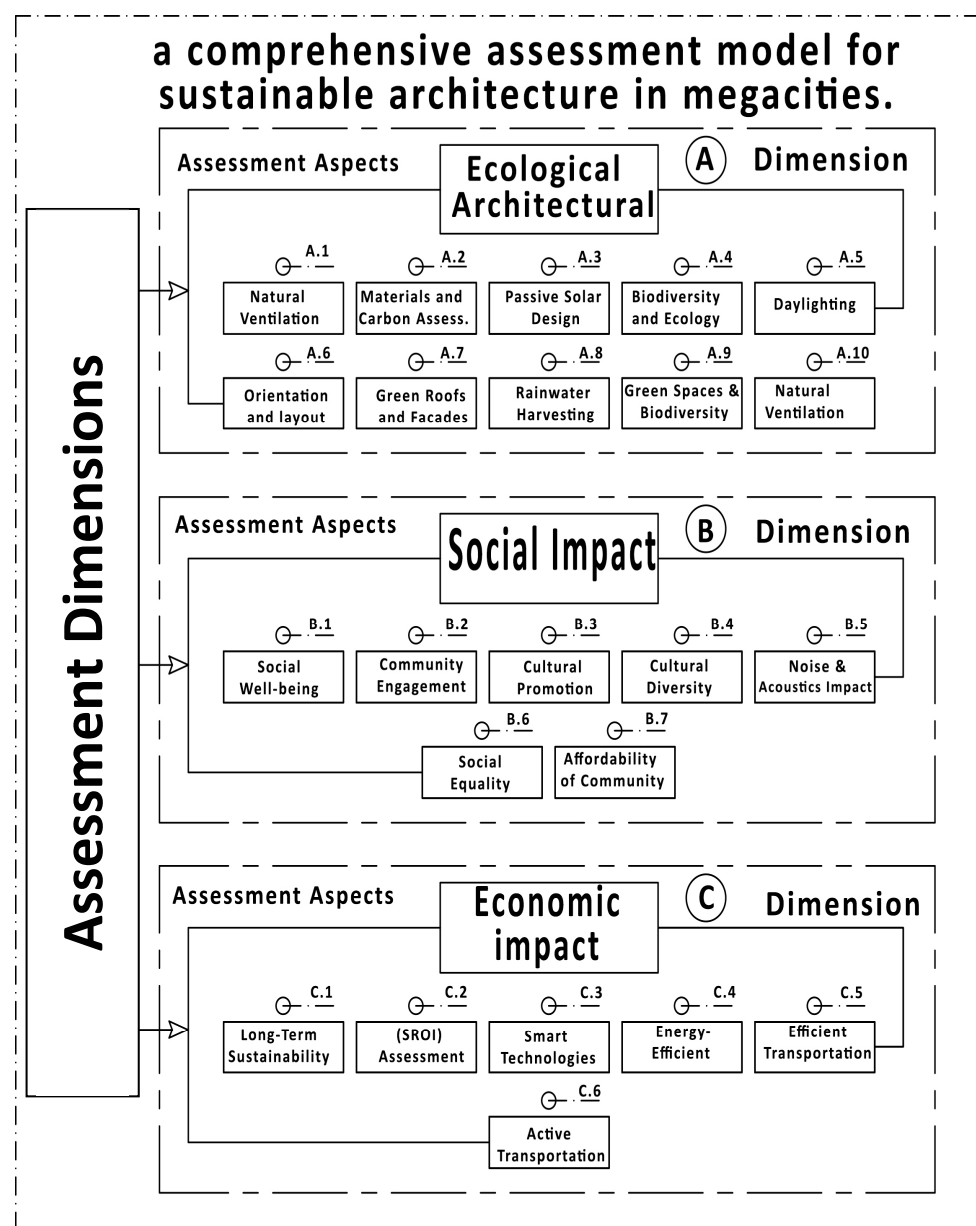


Figure 10. Illustration of a comprehensive assessment model for sustainable architecture in megacities. Source: Authors.

Table 2. Comprehensive assessment model for sustainable architecture in megacities. By the authors.

Dimension of Assessment	Specific Aspects	Evolution Points	Assessment Notes
A. Ecological architectural Dimension Assessment	A.1 Natural Ventilation	A.1.1 Incorporate natural ventilation systems to enhance indoor air quality and reduce the need for mechanical cooling.	All buildings based on artificial HVAC
		A.1.2 Design buildings with operable windows and ventilation pathways.	All buildings based on artificial HVAC
	A.2 Materials and Embodied Carbon Assessment	A.2.1 Evaluate environmental impact of construction materials.	Not applied
		A.2.2 Promote sustainable materials and techniques.	Not applied
	A.3 Passive Solar Design	A.3.1 Implement passive solar design principles to maximize natural heating and cooling.	Not applied
		A.3.2 Optimize building orientation and window placement.	Not applied. The majority of buildings in the government district do not take orientation into consideration, as well as extensive use of windows and fixed glass walls
	A.4 Biodiversity and Ecology Assessment	A.4.1 Assess architectural impact on local biodiversity.	Not applied
		A.4.2 Promote green landscaping for enhanced ecology.	Applied, but with the use of water-consuming crops
	A.5 Daylighting	A.5.1 Maximize the use of natural daylight to reduce artificial lighting needs.	Not applied. All buildings rely mostly on artificial lighting
		A.5.2 Design spaces with large windows and light shelves.	Applied, which increases the heat gain inside buildings and thus higher air conditioning energy consumption
	A.6 Orientation and layout that optimize natural heating and cooling using sunlight.	A.6.1 Passive solar design.	Not applied
		A.6.2 Inner courts solutions.	Not applied
	A.7 Green Roofs and Facades	A.7.1 Integrate green roofs and facades to improve insulation, reduce urban heat island effect, and enhance aesthetics.	Not applied
		A.7.2 Select native vegetation for green elements.	Not applied
	A.8 Rainwater Harvesting	A.8.1 Implement rainwater harvesting systems for non-potable water use, such as irrigation and toilet flushing.	Not applied
		A.8.1 Design collection and storage infrastructure.	Applied
	A.9 Green Spaces and Biodiversity	A.8.1 Green space design and native plantings.	Applied
		A.8.1 Wildlife-friendly urban planning.	Not applied
	A.10 Carbon Footprint Evaluation	A.8.1 Analyze carbon footprint across the building's life cycle.	Not applied
		A.8.1 Implement carbon reduction and energy efficiency measures.	Not applied

Table 2. Cont.

Dimension of Assessment	Specific Aspects	Evolution Points	Assessment Notes
B. Social Impact Assessment	B.1 Social Well-being and Health	B.1.1 Assess the impact of architectural designs on social well-being and public health.	Not applied
		B.1.2 Promote spaces that enhance physical and mental health.	Not applied
	B.2 Community Engagement and Participation	B.2.1 Involve local communities in planning and decision-making.	Not applied
		B.2.2 Foster a sense of ownership and pride among residents.	Not applied
	B.3 Cultural Diversity Promotion	B.3.1 Assess architectural design for cultural diversity.	Not applied. The design of the buildings did not pay attention to the local heritage and cultural diversity except by using heritage vocabulary as decoration in some cases
		B.3.2 Incorporate cultural elements into design.	Not applied. The design of the buildings did not pay attention to the local heritage and cultural diversity except by using heritage vocabulary as decoration in some cases
	B.4 Cultural Diversity Representation	B.4.1 Architectural designs that celebrate and preserve local cultural heritage.	Applied by using vocabulary from the Pharaonic heritage with monumental scales
		B.4.1 Using historical features in design or planning.	Using vocabulary from the Pharaonic heritage with monumental scales, the design of major squares, such as People's Square, adopted the axial design system and scales that express the magnitude
	B.5 Noise and Acoustics Impact Analysis	B.5.1 Evaluate design's impact on noise and acoustic comfort.	Not applied
		B.5.2 Implement soundproofing and noise reduction measures.	Not applied
	B.6 Social Equality Assessment	B.6.1 Examine how architectural practices promote social equality.	Not applied. There is no consideration for social equality and equal opportunities in obtaining suitable housing in these areas, as they are directed only to the rich
		B.6.2 Ensure inclusivity and accessibility in design.	Not applied, not applicable. Most of the external spaces between buildings cannot be used for the public
	B.7 Affordability of the Community	B.7.1 Evaluate the affordability of sustainable housing and amenities for all income levels within the community.	Not applied. There is no consideration and no equal opportunities in obtaining suitable housing in these areas, as they are directed only to the rich
		B.7.2 Develop strategies to address affordability challenges.	Not applied. Affordability was not taken into account among all citizens and was limited to the highest-income classes only

Table 2. Cont.

Dimension of Assessment	Specific Aspects	Evolution Points	Assessment Notes
C. Economic impact assessment	C.1 Long-Term Sustainability Evaluation	C.1.1 Assess contributions to long-term sustainability goals.	Not applied. Buildings or urban design do not reflect any interest in the idea of sustainability despite its presence in the government's media discourse, and the design documents and philosophies did not reflect any standards that commit to sustainability in the short or long term
		C.1.2 Monitor sustainability progress and adapt strategies accordingly.	Not applied
	C.2 Social Return on Investment (SROI) Assessment	C.2.1 Calculate broader economic benefits of sustainable architecture.	Not applied. There are no feasibility studies for the project, let alone the economic benefits of sustainable architecture
		C.2.2 Highlight economic advantages to stakeholders.	Not applied. There are no feasibility studies for the project
	C.3 Integration of Smart Technologies	C.3.1 Incorporate smart technologies such as building information modeling (BIM), IoT (internet of things).	Not applied
		C.3.2 Artificial intelligence (AI) to reduce operating costs, enhance occupant comfort, and improve maintenance efficiency.	Not applied
	C.4 Energy-Efficient Building Design	C.4.1 Design energy-efficient buildings with advanced insulation, efficient HVAC systems, and renewable energy sources.	Not applied
		C.4.2 Reduce energy consumption and emissions.	Not applied
	C.5 Efficient Transportation Systems	C.5.1 Develop and promote sustainable public transportation systems, including buses, trams, and subways.	Not applied
		C.5.2 Enhance connectivity within the megacity.	Applied. There is a good design of road networks within the district
	C.6 Active Transportation	C.6.1 Design pedestrian-friendly and bike-friendly infrastructure to encourage walking and cycling.	Not applied
		C.6.2 Reduce reliance on private vehicles.	Not applied

12. Results

Amid the rapid urbanization the world is witnessing, the pursuit of sustainability in urban development has become increasingly important. In this context, the research embarked on a quest to identify the complex nuances of sustainability within urban landscapes and formulate a robust assessment framework designed to evaluate the New Administrative Capital in Egypt. Here lies the examination of the important findings of the study, highlighting the major deficiencies observed in the implementation of the project and emphasizing the need for greater adherence to the principles of sustainability in urban development initiatives. The following points encapsulate the findings derived from the paper.

1. This paper primarily aimed to delineate the concepts of sustainability within the realm of urban development and to devise a comprehensive evaluation framework for assessing Egypt's New Administrative Capital, drawing from theoretical inquiries.

2. The paper yielded predominantly adverse findings attributed to critical factors such as the commencement of the project without conducting thorough feasibility studies. Additionally, there exists a notable absence of firmly established sustainability criteria, both in the architectural and urban planning domains, as well as in the adoption of construction methodologies and materials. This deficiency was particularly evident in the government district of the New Administrative Capital, which served as the primary focus of the investigation due to being the inaugural neighborhood completed within the capital.
3. It is noteworthy that despite official and media emphases on sustainability, the project appears to disregard the fundamental principles of social equity and equitable access to the urban model for all inhabitants. This discrepancy casts doubts on the project's genuine commitment to sustainability in practical implementation.
4. A significant disparity emerges between the government's rhetoric, which extols sustainability, and the actual implementation observed on the ground. This incongruity undermines the project's credibility as a sustainable blueprint for future urban development endeavors.
5. The exorbitant costs and expansive scale of the New Administrative Capital, promoted in media narratives as a sustainable exemplar, starkly contrast with the current reality. The sheer magnitude of the project's scope and budget prompts inquiries into its feasibility and long-term sustainability.
6. This paper advocates for broadening the application of the evaluation framework to encompass other project areas and advocates for continual enhancements. The objective is to evolve it into a comprehensive manual for establishing and adhering to sustainability standards in burgeoning urban centers, thereby rectifying the deficiencies identified in the New Administrative Capital project.
7. By refining the evaluation framework and deploying it across analogous projects, policymakers and urban planners can adeptly integrate sustainability principles into forthcoming developments, fostering more resilient and egalitarian urban environments.

13. Discussion

By delving into the theoretical concepts and principles explored in this research, which underscore the compelling need for large emerging cities to proactively embrace a sustainable approach, this study aims to shed light on the importance of sustainability in urban development. It also proposes a comprehensive model for the effective evaluation of this sustainability approach. Through the application of this model to the specific context of Egypt's New Administrative Capital, a comprehensive evaluation was conducted. The results derived from this evaluation, based on the majority of the specified criteria, have revealed a predominantly negative assessment. This negativity arises from several critical factors, including the project's initiation and lack of clear and comprehensive feasibility studies. Additionally, there is an absence of established sustainability standards, spanning from architectural and urban planning concepts to the selection of construction techniques and materials, with little to no consideration given to their environmental impact. Furthermore, the project seemingly disregards the essential standards pertaining to societal justice and ensuring that all citizens have equitable access to this modern urban model despite the prevalent use of the term "sustainability". Interestingly, a noticeable disparity exists between the government's official discourse, which emphasizes sustainability, and the practical implementation observed on the ground. This is evident when evaluating the results of the applied assessment model within the government-controlled region. The exorbitant estimated cost of developing the New Administrative Capital, which some place at USD 50 billion, coupled with its immense size—approximately three times that of Singapore—suggests it was intended to serve as a sustainable model. However, critics express concern over the expense, particularly as the country grapples with economic challenges and heightened pressures from the Gaza conflict. Egypt's economy receives support from international sources, including the World Bank, which recently announced

a funding commitment of over USD 6 billion over three years. In light of these critical findings, this research advocates for the expanded application of the proposed evaluation model to other comprehensive areas within the same project. Additionally, there is a call for ongoing refinement and development of this model, with the ultimate goal of transforming it into a comprehensive guide for establishing and adhering to sustainability standards in the context of large emerging cities.

14. Conclusions and Findings

Based on the research results, it is evident that the New Administrative Capital project in Egypt fails to meet established sustainability standards within the government district. Despite official government discourse emphasizing the adoption of sustainability practices in the administrative capital, the project began without comprehensive feasibility studies and lacks well-established sustainability standards in architectural, urban planning, and construction aspects. Previous analyses also indicate that the project disregards societal justice standards, leading to many citizens being unable to access housing in the new capital. This highlights a significant gap between the government's rhetoric on sustainability and its practical implementation. The high cost and enormous size of the New Administrative Capital conflict with Egypt's current economic situation. Critics express concern about this cost, especially given the economic challenges facing Egypt and the increasing pressures resulting from external conflicts. While the project receives international financing support, including assistance from the World Bank, concerns persist about its sustainability and alignment with societal needs. In light of these findings, the research calls for expanding the scope of application of the evaluation model to include areas that have not been addressed in the New Administrative Capital. It emphasizes the importance of ensuring adherence to sustainability standards in large emerging cities and addressing critical gaps in urban development planning and implementation to reflect an appreciation of sustainability.

Author Contributions: H.S.S. played a central role in the conceptualization of ideas, formulation of overarching research goals and aims, and the development and design of the methodology, including the creation of models. Additionally, H.S.S. contributed significantly to the investigation process, conducting experiments and overseeing the data/evidence collection. M.S.M. contributed to the data curation, formal analysis, and validation. A.A. was instrumental in the project's administration, managing, and coordinating research activity planning and its execution, as well as in securing the financial support for the project in addition to formulation of overarching research goals and aims, leading to this publication. A.A. also contributed to the resources. All authors, including H.S.S., M.S.M. and A.A., participated in writing, reviewing, editing, critically revising, commenting, and revising the paper at various stages. Additionally, H.S.S. played a key role in language review, ensuring clarity and coherence in the manuscript. All authors have read and agreed to the published version of the manuscript.

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References

1. Alsharif, H.; Bugdady, L. Sustainable architecture in megacities: A review study. *Int. J. Sci. Res.* **2019**, *8*, 1174–1178.
2. Stone, B., Jr.; Marans, R. The Ecology of Urban Design: A Case Study of a Sustainable Community. *Environ. Plan. B Plan. Des.* **2015**, *42*, 295–310.
3. Ilesanmi, A.O. Urban sustainability in the context of Lagos mega-city. *J. Geogr. Reg. Plan.* **2010**, *3*, 240–252.
4. Bissoonauth, C.; Herr, C.; Fischer, T. Sustainable Architecture for Future High-Density Cities: An Applied Design Approach. *KnE Soc. Sci.* **2019**, *3*, 5557. [CrossRef]
5. Serag, Y. The New Administrative Capital Of Egypt: A Critical Review From The Regional Perspective. In Proceedings of the Quality of Life Conference (1st) “Towards a Better Quality of Life”, El Gouna, Egypt, 24–26 November 2017.
6. Abdel Fattah, H.S. Development and Growth in New Cities (Cases of New Cities in the Arab Republic of Egypt). Master’s Thesis, Faculty of Engineering, Cairo University, Cairo, Egypt, 2002. (In Arabic)
7. Sims, D. *Understanding Cairo: A City Out of Control*; American University in Cairo Press: Cairo, Egypt, 2015.
8. Lindsey, U. The Anti-Cairo. *Places J.* **2017**. [CrossRef]
9. United Nations. World Urbanization Prospects 2018. Available online: <https://population.un.org/wup/Publications/Files/WUP2018-Report.pdf> (accessed on 25 August 2022).
10. United Nations University. 2015 Annual Report. p. 20, ISBN 978-92-808-9027-3. Available online: https://i.unu.edu/media/unu.edu/publication/85565/unu_ar2015_en.pdf (accessed on 20 July 2023).
11. Bugliarello, G. Megacities and the developing world. *Bridge* **1998**, *29*, 19–26.
12. Labisi, A. Lagos megacity or mega-slum? Towards a sustainable Lagos megacity development: Some basic planning considerations. *J. Sustain. Dev. Afr.* **2012**, *14*, 145–159.
13. Heinrichs, D.; Nuissl, H.; Stelzer, V. *Risk Habitat Megacity—Strategies for Sustainable Development in Megacities and Urban Agglomerations*; Forum DKKV/CEDIM: Disaster Reduction in Climate Change; Karlsruhe University: Karlsruhe, Germany, 2007.
14. Mavropoulos, A. Megacities Sustainable Development and Waste Management in the 21st Century. In Proceedings of the ISWA Conference, Hamburg, Germany, 10–15 November 2010.
15. Castells, M. *The Rise of the Network Society, The Information Age: Economy, Society and Culture Vol. I*, 2nd ed.; Malden, M.A., Ed.; Blackwell: Oxford, UK, 1996; ISBN 978-0-631-22140-1.
16. Phdungsilp, A. Energy Analysis for Sustainable Mega-Cities. Bachelor’s Thesis, School of Industrial Engineering and Management, Department of Energy Technology, Royal Institute of Technology, Stockholm, Sweden, 2006.
17. United Nations. *World Urbanization Prospects: The 2018 Revision*; United Nations, Department of Economic and Social Affairs, Population Division: New York, NY, USA, 2020.
18. Ali, M.; Zhang, Y. Developing a smart and sustainable new administrative capital (NAC) in Cairo, Egypt: A critical review. *J. Clean. Prod.* **2021**, *292*, 126090.
19. Schatz, E. What capital cities say about state and nation building. *Natl. Ethn. Politics* **2022**, *9*, 122–129. [CrossRef]
20. Ni, P.; Kamiya, M.; Ding, R. Global urban competitiveness: Theoretical framework. In *Cities Network Along the Silk Road*; Springer: Singapore, 2017; pp. 15–29.
21. Khorshed, M. Cairo’s New Administrative Capital Wedian City: Lessons from the Past and for the Future. Master’s Thesis, Department of Urban Studies and Planning, Massachusetts Institute of Technology, Cambridge, MA, USA, 2017.
22. Oren, A.; Goldman, L.; Shanti, M. What Makes a World Class City? Available online: https://ssir.org/articles/entry/what_makes_a_world_class_city (accessed on 11 January 2021).
23. Egypt Today. New Administrative Capital to represent sustainable, smart city: El-Sisi. *Egypt Today*, 13 November 2018.
24. Darwish, M. Sustainable urbanism in the new administrative capital in Egypt. *J. Archit. Plan. Res.* **2019**, *36*, 126–141.
25. Ali, A.N.A.; Jainudin, N.A.; Tawie, R.; Jugah, I. Green Initiatives in Kota Kinabalu Construction Industry. *Procedia Soc. Behav. Sci.* **2016**, *224*, 626–631. [CrossRef]
26. Patel, P.; Patel, A. Use of sustainable green materials in construction of green buildings for sustainable development. *IOP Conf. Ser. Earth Environ. Sci.* **2021**, *785*, 012009. [CrossRef]
27. Giuffré, L.; Bonafina, C.; Vespasiano, C.; Ciarlo, E. Social Impact of Urban Green Spaces. *IOSR J. Humanit. Soc. Sci.* **2019**, *24*, 29–35.
28. Giuiliano, G.; Calabrò, F.; Scarpa, F. Economic analysis of sustainable design on building renovation. *Sustainability* **2018**, *10*.
29. Bali, A.; Kumar, P.; Gaurav, K.; Bhatia, R. Compact city framework for urban sustainability: A review. *J. Urban Manag.* **2021**, *10*, 71–87.
30. Srivastava, S.K.; Varma, R.; Kumar, S.; Chauhan, R. Urban sustainability through green urbanism: A review. *J. Clean. Prod.* **2018**, *172*, 2984–3001.
31. Sang, J.; Pan, L. Impact of Green Infrastructure Investment on Urban Carbon Emissions in China. *Sustainability* **2024**, *16*, 2668. [CrossRef]
32. Balaras, C.A.; Pollaki, A.; Kyriakarakos, G. A study of the energy efficiency and renewable energy techno-economics in residential buildings. *Renew. Energy* **2007**, *32*, 76–90.
33. EPA. Water Sense. Available online: <https://www.epa.gov/watersense> (accessed on 7 August 2021).
34. Bai, X.; Dawson, R.J.; Urquijo, J.; Vercruysse, K. Planning for water-sensitive cities: Investigating the role of the institutional framework. *Water Sci. Technol.* **2010**, *61*, 2933–2943.

35. The City of Copenhagen. Copenhagen—A City for People. Available online: <https://denmark.dk/people-and-culture/the-danish-welfare-society/copenhagen-a-city-for-people.2021> (accessed on 6 July 2023).
36. Lami, I.; Mecca, B. Assessing Social Sustainability for Achieving Sustainable Architecture. *Sustainability* **2020**, *13*, 142. [CrossRef]
37. Dong, X. Research and Application of the Sustainable Architectural Design Theory. In Proceedings of the 3rd International Conference on Architecture: Heritage, Traditions and Innovations (AHTI 2021), Moscow, Russia, 9–10 March 2021; pp. 72–78. [CrossRef]
38. Jacomit, A.M.; Silva, V.G.; Ariovaldo, D.G. Can sustainable buildings cost the same as conventional buildings? In Proceedings of the 3rd CIB International Conference on Smart and Sustainable Built Environments, Delft, The Netherlands, 15–19 June 2009.
39. Lee, W.; Kim, Y.S.; Lim, Y.J. Perception study on sustainable architecture in the context of current megacities. *Sustainability* **2019**, *11*, 327.
40. Brown, R.R.; Rogers, B.C.; Werbeloff, L. A Framework to Guide Transitions to Water Sensitive Cities. In *Urban Sustainability Transitions*; Springer: Berlin/Heidelberg, Germany, 2022; pp. 129–148. [CrossRef]
41. Jacobson, M.Z.; Delucchi, M.A.; Bauer, Z.A.F.; Goodman, S.C.; Chapman, W.E.; Cameron, M.A.; Bozonnat, C.; Chobadi, L.; Clonts, H.A.; Enevoldsen, P.; et al. 100% Clean and Renewable Wind, Water, and Sunlight All-Sector Energy Roadmaps for 139 Countries of the World. *Joule* **2015**, *1*, 108–121. [CrossRef]
42. Bragança, L.; Vieira, S.; Andrade, J. Early Stage Design Decisions: The Way to Achieve Sustainable Buildings at Lower Costs. *Sci. World J.* **2014**, *2014*, 365364. [CrossRef] [PubMed]
43. El-Attar, H. Sustainability and future smart city in Egypt: The case of the New Administrative Capital. *J. Urban Manag.* **2018**, *7*, 22–33.
44. Elsaed, K.; Helal, H.; Elshahat, N.; Rady, T. Suggested methods for assessing the environmental and economic impacts of development projects in Egypt to achieve sustainable development. *IOSR J. Econ. Financ.* **2022**, *13*, 27–48.
45. Hussein, S.; Abdelhalim, M. Green Building Rating Systems in Developing Countries: Case Study—Egypt. *J. Constr. Eng. Manag.* **2019**, 139–145.
46. The Times. Egypt’s \$45bn White Elephant: New Capital City Sparks Controversy. Available online: <https://www.thetimes.co.uk/article/egypts-45bn-white-elephant-new-capital-city-sparks-controversy-vlc9cjgqm> (accessed on 4 May 2020).
47. Sadik, N.M. Sustainable architecture in Egypt: Conceptual framework for green building design. *HBRC J.* **2018**, *14*, 157–163.
48. Lützkendorf, T.; Kabisch, S.; Saha, F. Sustainable urban development through responsible investment: A critical analysis of the financialization of green buildings in megacities. *Urban Stud.* **2019**, *56*, 1429–1446.

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