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The Concept of the Line City

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ABSTRACT:The Line is a proposed city development project in Saudi Arabia that aims to create a sustainable and technologically advanced urban environment. It is part of the larger NEOM project, a \$500 billion mega-city development project that is designed to be a hub of innovation, technology, and sustainable living. The Line will be a 170 km-long linear city built around a series of key industries, including biotech, renewable energy, and advanced manufacturing. It is planned to have a population of one million people and will be powered entirely by renewable energy sources. The city will also have no cars or roads, with transportation instead relying on ultra-high-speed transit systems and autonomous vehicles. The Line's design is centered around a focus on nature and green spaces. It is envisioned as a model for the future of urban development, emphasizing sustainability, innovation, and quality of life. The city's infrastructure will be built underground, leaving the surface level free for green spaces and recreational areas. The city will also be designed to minimize energy consumption, waste production, and carbon emissions. The Line is expected to create new opportunities for research and development in a range of industries, as well as to attract investment and talent from around the world. It is intended to be a hub for innovation, a living laboratory for sustainable living, and a showcase for the potential of technology and design to shape the future of urban living.

KEYWORDS:The Line, NEOM, Megacity project, Sustainable urban environment, Future city, Technology and innovation, AI and robotics, Renewable energy sources, Environmental impact, Resource utilization, Green spaces, Public transportation systems, Economic growth and development, Car-free zone, Clean energy sources.

I. INTRODUCTION

The Line is a new planned city located in the Tabuk region of Saudi Arabia, which is set to cover an area of 34 km² and extend over 170 kilometers. The city is designed to provide accommodation for around one million people with a focus on sustainability and innovation. One of the main features of the city is that it will be pedestrian-friendly, with no cars, roads, or carbon emissions, and will instead rely on renewable energy sources such as wind and solar power to meet 100% of its energy needs.

Advanced technology and infrastructure will be a key part of The Line's design, with autonomous vehicles, drones, and smart homes all being incorporated into the city's plan. The city will be divided into multiple sectors, including residential, commercial, and industrial zones. The residential sector will offer a range of housing options, including villas, townhouses, and apartments, while the commercial sector will include shopping malls, entertainment centers, and restaurants. The industrial sector will focus on industries such as renewable energy, biotechnology, and advanced manufacturing.

The Line is a significant part of Saudi Arabia's Vision 2030 plan, which aims to diversify the country's economy and reduce its dependence on oil. The project is being developed by NEOM, a company established by the Saudi Arabian government to develop a new model for sustainable living. It is expected to create job opportunities and stimulate economic growth in the region.

The plan for The Line, a new city located in the Tabuk region of Saudi Arabia, was announced on 10 January 2021 by the Saudi Crown Prince in a presentation that was broadcast on state television. Earthworks for the project began in

October 2021, and it was expected that the first residents would move in by 2024. As of July 2022, the first phase of the project was scheduled to be completed by 2030.

Crown Prince Mohammed Bin Salman, who is also the Chairman of the NEOM board of directors, released a statement and promotional video on 25 July 2021, which led to increased media coverage of the project. This raised concerns among some critics about the design of the city and potential environmental issues. They were particularly concerned that the project could create a "dystopian" and "artificial" facility, which had already displaced the Huwaitat indigenous tribe and could impact the migration of birds and wildlife. These issues are expected to be addressed as the project moves forward.

The Line project management required all architects to sign confidentiality agreements, resulting in no public references to The Line on any of the architects' websites. However, German newspaper Süddeutsche Zeitung reported that two well-known architects, Norman Foster and Francine Houben from Mecanoo, terminated their participation in the project due to human rights and ecological concerns. The newspaper also claimed that several high-ranking architects were still on board, including David Adjaye, Ben van Berkel of UN Studio, Massimiliano Fuksas, the London office of Zaha Hadid Architects, Rem Koolhaas, the Laboratory for Visionary Architecture (LAVA), as well as DeluganMeissl and Wolf D. Prix from Coop Himmelb(l)au.

Süddeutsche Zeitung criticized the architects for their perceived lack of consideration for sustainability and ethical issues. The newspaper claimed that the architects' involvement in the project reflected double standards in moral issues. However, it is important to note that the architects may have had different reasons for their involvement or withdrawal from the project, and their precise motivations remain unclear due to the confidentiality agreements they signed.

The Line project in Saudi Arabia has faced several criticisms regarding its design, sustainability, and human rights implications. In terms of design, experts have raised concerns about the feasibility of achieving the futuristic and slick aesthetic shown in the concept art, citing the complexity of large-scale urban planning. Some architects have also criticized the monotonous profile of the project and the potential for unfavorable wind flow through the interior. In terms of sustainability, experts have noted the project's high carbon footprint due to the use of glass, steel, and concrete. The 170-km profile of The Line could also create a significant barrier to adjacent ecosystems and migratory species, similar to that created by highways. Additionally, the mirrored exterior facade of the buildings could be dangerous for birds.

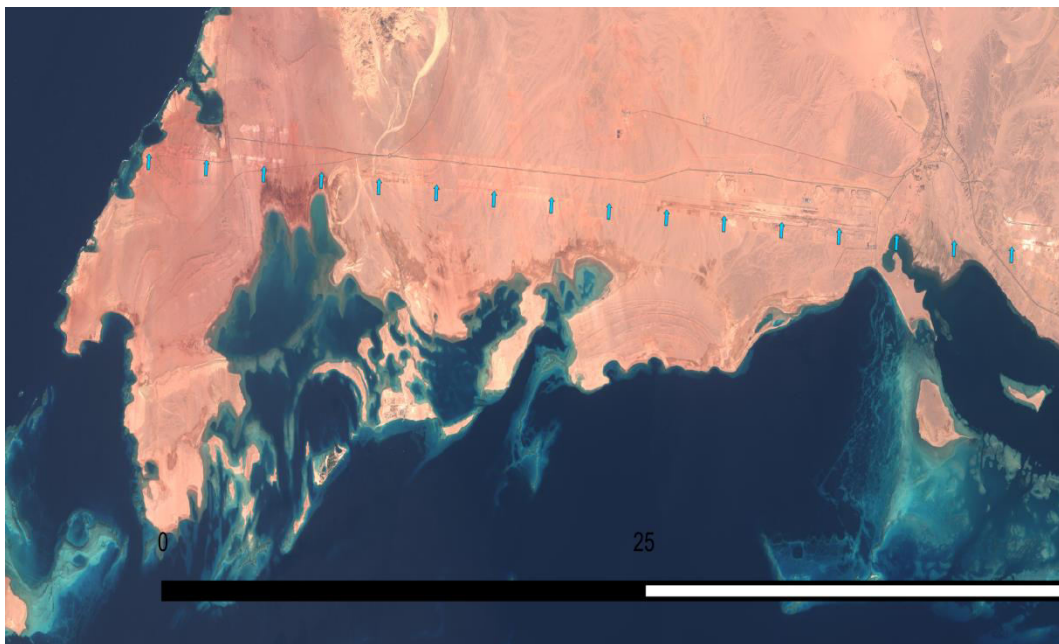


Fig.No. 1 Current excavation progress of The Line.
(as of October 17th and 19th 2022). Location: 28° 8' 24" N, 34° 56' 24" E



In October 2022, drone footage released confirmed that construction on The Line was underway and excavation works were taking place along the entire length of the project.

The image depicts a progress report on The Line project in Saudi Arabia, as of October 2022. The report shows the project's development in different stages, such as planning, design, construction, and operation.

At the planning stage, the report shows that the project has completed 25% of its planning, with an emphasis on sustainability and innovation. The design stage, on the other hand, has progressed 3%, with a focus on environmental and social sustainability, as well as developing a pedestrian-focused infrastructure.

In terms of construction, the report indicates that the project has completed 5% of its construction, with an emphasis on building an infrastructure that can withstand extreme weather conditions, such as high winds and extreme temperatures. The report also shows that the project has started working on the operation stage, with an emphasis on developing an integrated transportation system that includes autonomous vehicles and public transportation.

The progress report also provides a breakdown of the different sectors of the project, such as residential, commercial, and industrial. It shows that the residential sector has progressed the most, with 10% of its construction completed, followed by the commercial sector at 5% and the industrial sector at 1%.

Overall, the progress report provides a glimpse into the current state of The Line project in Saudi Arabia, indicating that it is still in the early stages of development but making steady progress towards its completion.

II. LITERATURE SURVEY

“Rahama M. Doheim , Alshimaa A. Farag , SamaaBadawi” [1]

The article "Smart city vision and practices across the Kingdom of Saudi Arabia: a review" by Rahma M. Doheim and AlshimaaFarag provides an overview of the smart city initiatives and practices in Saudi Arabia. The paper reviews the smart city projects and initiatives in major cities of Saudi Arabia such as Riyadh, Jeddah, Makkah, Madinah, and Dammam. It also analyzes the role of various stakeholders, such as the government, private sector, and citizens, in implementing smart city projects.

The paper highlights the importance of smart city initiatives in enhancing the quality of life of citizens, improving the efficiency of public services, and promoting economic growth. It discusses the various components of smart city infrastructure such as ICT, transportation, energy, and environment, and their interdependencies. The paper also examines the challenges and opportunities of smart city initiatives in Saudi Arabia, such as the need for proper governance, stakeholder engagement, and technological readiness.

Overall, the article provides a comprehensive overview of the smart city vision and practices in Saudi Arabia, highlighting the opportunities and challenges of implementing smart city projects in the country.

“Amna Al-Sayed ,Faizah Al-Shammari , AreejAlshutayri”[2]

The article titled "Smart City Strategies and Policies: A Comparative Analysis of Barcelona, Dubai, and Singapore" discusses the strategies and policies adopted by Barcelona, Dubai, and Singapore to transform themselves into smart cities. The authors provide a comparative analysis of the three cities based on different aspects, such as the history and context of smart city development, the strategies and policies adopted, the implementation of smart city technologies, and the outcomes and impacts of smart city initiatives. The article highlights the importance of understanding the unique context and challenges of each city and tailoring smart city strategies accordingly. It also emphasizes the need for collaboration and partnership between different stakeholders to achieve sustainable and inclusive smart city development. Overall, the article provides valuable insights and recommendations for policymakers and practitioners interested in smart city development.

“Nasser AlqahtaniAndNazmiyeBalta-Ozakan” [3]

This is a research article titled "Assessment of Rooftop Solar Power Generation to Meet Residential Loads in the City of Neom, Saudi Arabia". The article discusses the potential of rooftop solar power in meeting the residential energy demands of the newly planned city of Neom in Saudi Arabia. The research assesses the feasibility of rooftop solar power generation in the city by analyzing the solar radiation and energy demand data of the city. The study also considers the economic and environmental aspects of the solar power generation system. The authors suggest that rooftop solar power generation can be a promising solution for meeting the residential energy demands of Neom while also reducing carbon emissions and promoting sustainability.



“Natalia E. Paszkowska-Kaczmarek” [4]

The article "The Line – The Saudi-Arabian Linear City Concept as the Prototype of Future Cities" by Natalia E. Paszkowska-Kaczmarek provides a detailed analysis of The Line project in Saudi Arabia. The author examines the concept and design of The Line, as well as its potential impact on the future of urban development.

The article first provides an overview of The Line project, describing its location, length, and purpose. The author then analyzes the design principles and features of The Line, including its emphasis on sustainability, mobility, and technology. Paszkowska - Kaczmarek also discusses the challenges and limitations of The Line, such as the need for advanced infrastructure and potential environmental concerns.

In addition, the article explores the potential impact of The Line on the future of urban development, highlighting its potential as a model for sustainable, high-tech cities. The author argues that The Line represents a significant step forward in urban planning and design, and that it has the potential to inspire similar projects in other parts of the world. Overall, the article offers a comprehensive analysis of The Line project, providing insights into its design, potential impact, and broader significance for the future of urban development.

“AlshimaaAboelmakaremFarag”[5]

A book chapter titled "The Story of NEOM City: Opportunities and Challenges," written by Yasser Al-Saleh and published in the book "Smart and Sustainable Planning for Cities and Regions" in 2021.

The chapter provides an overview of NEOM City, a planned futuristic megacity in the northwest of Saudi Arabia, which is envisioned to be a hub for innovation, technology, and sustainable development. It highlights the economic and strategic importance of NEOM City for Saudi Arabia and the region, and describes its master plan, which aims to create a livable and sustainable city based on renewable energy, smart infrastructure, and advanced technologies.

The chapter also discusses the challenges and opportunities of building NEOM City, including the need for significant investments, the importance of stakeholder engagement, and the potential social and environmental impacts of the project. It highlights the importance of ensuring inclusivity, diversity, and cultural sensitivity in the development of NEOM City, and emphasizes the need for comprehensive planning and effective governance to ensure the success of the project.

Overall, the chapter provides a comprehensive overview of NEOM City and its potential as a prototype for future sustainable cities. It offers insights into the opportunities and challenges associated with large-scale urban development projects and highlights the importance of integrating social, economic, and environmental considerations into the planning and implementation of such projects.

“Hari Prasad Dasari ,SrinivasDesamsetti , Rama Krishna Karumuri1 , Shyamcharan Singh”[6]

The article "Atmospheric particulate matter in the city of Jeddah: characterization and source identification" presents a study on the characterization and source identification of atmospheric particulate matter (PM) in the city of Jeddah, Saudi Arabia. The study collected PM samples using a high-volume sampler from two different locations in Jeddah and analyzed them for their chemical composition and sources using X-ray fluorescence (XRF), ion chromatography (IC), and scanning electron microscopy (SEM). The results of the study showed that the PM in Jeddah is dominated by crustal elements, followed by anthropogenic and marine sources. The anthropogenic sources included combustion-related elements such as S, V, Zn, and Pb, while the marine sources included Na, Cl, and Mg. The study also found that the PM concentration in Jeddah exceeded the World Health Organization (WHO) guidelines, indicating a potential health risk to the population. The authors suggest that the results of this study can inform policymakers and public health officials on the need for improved air quality management strategies in Jeddah.

“ArbertoBoretti”[7]

The article discusses the integration of solar thermal and photovoltaic, wind, and battery energy storage through artificial intelligence (AI) in NEOM city. NEOM city is a futuristic city that is being built in the northwest of Saudi Arabia, with the aim of becoming a world leader in sustainable energy and advanced technologies.

The article proposes a hybrid energy system that combines various renewable energy sources such as solar thermal, photovoltaic, and wind power, along with battery energy storage to provide a reliable and stable supply of energy to the city. The system is managed and controlled by an AI-based optimization algorithm that aims to minimize energy costs and carbon emissions while ensuring a reliable supply of energy to the city.

The article describes the various components of the proposed hybrid energy system and their integration through the AI-based optimization algorithm. It also discusses the expected benefits of the system, including reduced energy costs, improved energy efficiency, and reduced carbon emissions.



Overall, the article provides insights into the potential of AI-based optimization algorithms to manage and control complex energy systems in future cities such as NEOM . The article discusses the integration of various renewable energy sources, including solar thermal and photovoltaic, wind, and battery energy storage, using artificial intelligence (AI) in NEOM city. The study proposes a hybrid energy system that integrates the various sources of renewable energy using AI to optimize energy production and consumption. The authors suggest that this system has the potential to meet the energy needs of the NEOM city, which is envisioned as a sustainable, futuristic urban center.

III. SYSTEM DEVELOPMENT

The NEOM project is considered the most ambitious undertaking in the world and a symbol of a bold step forward in the advancement of humanity. It is a reflection of creativity in the field of environmental preservation and will be a destination for individuals who desire to be a part of creating a new model for extraordinary living. The City of THE LINE, which will be located in NEOM, is hailed as a model for what urban communities may be in the future and a strategy that promotes a healthy balance between human and natural environments.

The City of THE LINE will consist of interconnected cognitive communities that will be strengthened by artificial intelligence along a 170-kilometer stretch of land, within which there will be an environment free of noise and pollution, as well as free of automobiles and traffic congestion. The city will be powered by renewable energy, with plans to produce 100% of its energy from renewable sources, including wind and solar power.

The NEOM project is a direct answer to the issues of urban expansion that are impeding the advancement of civilization, such as deteriorating infrastructure, environmental pollution, and urban and population sprawl. It is expected to drive economic growth and create job opportunities in the region. Smart city implementation is also being promoted in Saudi Arabia, with the use of information and communication technology to perceive, analyse, and integrate vital information for running cities, responding to a variety of needs such as daily life, environmental preservation, public safety, and city services.

The area where the NEOM project will be executed offers optimal conditions for the generation of electricity from renewable sources such as solar and wind energy. Management of NEOM projects must be implemented with the resources that are easily available in today's environment. Overall, the NEOM project represents a vision of a sustainable and innovative future for Saudi Arabia and the world



Fig. No. 2 Layers of The Line.

The Line, a smart city being developed in Saudi Arabia, has a unique advantage despite its extensive length of 170 km. Travel time from one end of the city to the other is estimated to take only 20 minutes, making it a highly accessible urban center. Furthermore, the project will preserve 95% of the natural environment in the NEOM lands, ensuring that the development is sustainable and environmentally conscious. The city will be powered entirely by renewable energy sources, achieving a 100% reliance on clean energy.



Fig. No. 3 Some of its distinctive characteristics (Neom, 2021)

The text discusses a new city concept called "The Line" that is being developed in Saudi Arabia. The city will be pedestrian-friendly with no cars, roads, or carbon emissions, and will be powered by renewable energy sources such as wind and solar power. The city will have multiple sectors including residential, commercial, and industrial with a focus on sustainable industries such as renewable energy, biotechnology, and advanced manufacturing. The project is part of Saudi Arabia's Vision 2030 plan, which aims to diversify the country's economy and reduce its dependence on oil.

The text goes on to discuss the global challenge of providing clean water and food to an increasing population, and how this poses the most significant challenge for the human species. The text suggests that overpopulation is the fundamental problem and that a day will come when our planet's ability to generate enough food and water for all of us will be jeopardized, and we will be forced to adapt.

Despite the commendable concept of The Line, the text argues that it will only serve to exacerbate the fundamental problem of an uncontrolled and limitless population constrained by a finite supply of food and water. The elimination of pollution from transportation and road fatalities is commendable, but humans have only been given a certain supply of water, which is vital to our survival as a species. The text suggests that in order to make a positive contribution to the preservation of the human species, people must recognize that there are simply too many people on the earth at any particular time.

The author of the text suggests that they have decided to forsake the delights of raising children and raising grandkids as a way to contribute to the preservation of the human species. The text argues that it is imperative that we as a nation and as a people solve the issue of overpopulation, and the longer we wait, the more difficult it will become.

The materials are selected based on their properties, such as strength, durability, and flexibility. The selected materials are then cut, shaped, and assembled into the desired form, often using specialized tools and techniques. Once the model is complete, it is typically tested to ensure that it meets the desired specifications and functions as intended. Throughout the process, attention to detail and precision are crucial to ensuring the accuracy and reliability of the final product. While the specific details of the model making process may vary depending on the intended use and complexity of the model, these basic steps are typically followed to create a successful model.



Fig. No. 4 Prototype Model of The Line City



Fig. No. 5 For Showing Internal Amenities of The Line City.

IV. CONCLUSION

In conclusion, the completion of the NEOM project by 2025 is part of Saudi Arabia's Vision 2030 plan to become a leading global model in various areas of life, with a particular focus on the development of future cities. The Line, as one of the major components of NEOM, prioritizes human well-being, sustainability, and accessibility, and relies



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heavily on advanced technologies such as artificial intelligence. The use of artificial intelligence is considered crucial for the Kingdom of Saudi Arabia to revolutionize urban life and transition away from hydrocarbon fuels.

This research suggests that artificial intelligence will play a significant role in the future development of Saudi Arabia, particularly in the technology sector. The incorporation of artificial intelligence into The Line project is expected to provide a qualitative leap forward for the Kingdom of Saudi Arabia in terms of technological advancement, economic growth, and job creation. Overall, The Line project and the use of advanced technologies such as artificial intelligence demonstrate Saudi Arabia's commitment to transforming the country's economy and achieving its Vision 2030 goals.

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