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Outer Space Activities and City Evolution

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Abstract

Just as the space community is expanding our presence into the solar system and beyond, a group of thought leaders, including visionary policy makers, architects, engineers and allied professionals are peering into the Earth, studying co-relations of various dynamic systems including land, air and sea agents, and finding new ways to report and apply the data from space-based assets, for the immediate betterment of humanity.

New cities are emerging, established towns are growing and expanding, and many metropolises are merging to become megalopolises around the globe. And urban infrastructures around the world are coping hard to adjust to new pressures including the huge population migration from rural to urban regions, climate change effects, and vital resources, all in an effort to sustain and enhance the quality of life of the citizen.

Providing a safe, productive and nurturing environment for the city dweller is the overarching directive and prime aim of every city and city management. Enhancing and safely delivering a range of cradle-to-grave activities to sustain the quality of life of the citizen including incorporating agile, responsive systems for health and welfare, economic opportunities, leisure and safety are all part of the evolving Smart City paradigm.

This paper presents the potential for improving the quality of life of the city dweller by applying mature, adaptable and appropriately viable space technologies. By applying lessons learned so far, and using environmentally friendly space technologies, both employed by or being developed in the space community for outer space activities, space systems and practices can be adopted directly or adapted to enhance city life, while also paying attention to 21st century UN sustainable development goals.

Specifically, energy production and distribution, the scaling of environmental control and life support systems to accommodate large populations, atmospheric scrubbing and revitalization, production of potable water and recycling waste water and solids can be deployed at scale in cities. In addition, efficient food production and pollution-free, local and long haul transportation and related autonomous agents and allied robotic technologies coupled with agile 5G+ communication networks that allow Internet of Things(IoT) across a myriad of devices for monitoring and responding to citywide needs like traffic and resource management are all related to spacecraft systems in use or in advanced development stages today.

It is concluded that environmentally friendly space activity and allied technologies can have immense positive impact yet to be realized in city evolution, and that the Smart City paradigm being currently rolled out across the world stand to benefit tremendously from integrating outer space technologies into deeper layers of city infrastructure.

USC School of Architecture has the most diverse student body among American universities. Aspects of potential, progressive developments possible through the use of advanced space and allied technologies in certain world cities are presented by a diverse group of students from around the globe who sat in the 3-unit Space and City seminar in the Spring of 2020.

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I. Introduction

Just as the space community is expanding our presence into the solar system and beyond, a group of thought leaders, including visionary policy makers, architects, engineers and allied professionals are peering at Earth, studying co-relations of various dynamic systems including land, air and sea agents, and finding new ways to report and apply the data from space-based assets, for the immediate betterment of humanity. NASA satellites are observing the oceans, the land forms and ice-sheets in the polar regions, the climate and the weather, as well as the impact of human activities in cities around the globe all in real time. Atmospheric quality, affected by human industry, effluents and pollution, fires and hurricanes and tornadoes are all being monitored by space-based assets.[Figure 1.] Recently, a new layer of communication satellites are being commissioned that will speed up data delivery all over the globe, allowing even better and more accurate monitoring and forecasting of the very complex and dynamic systems that make up the planet's biosphere and ecosphere.

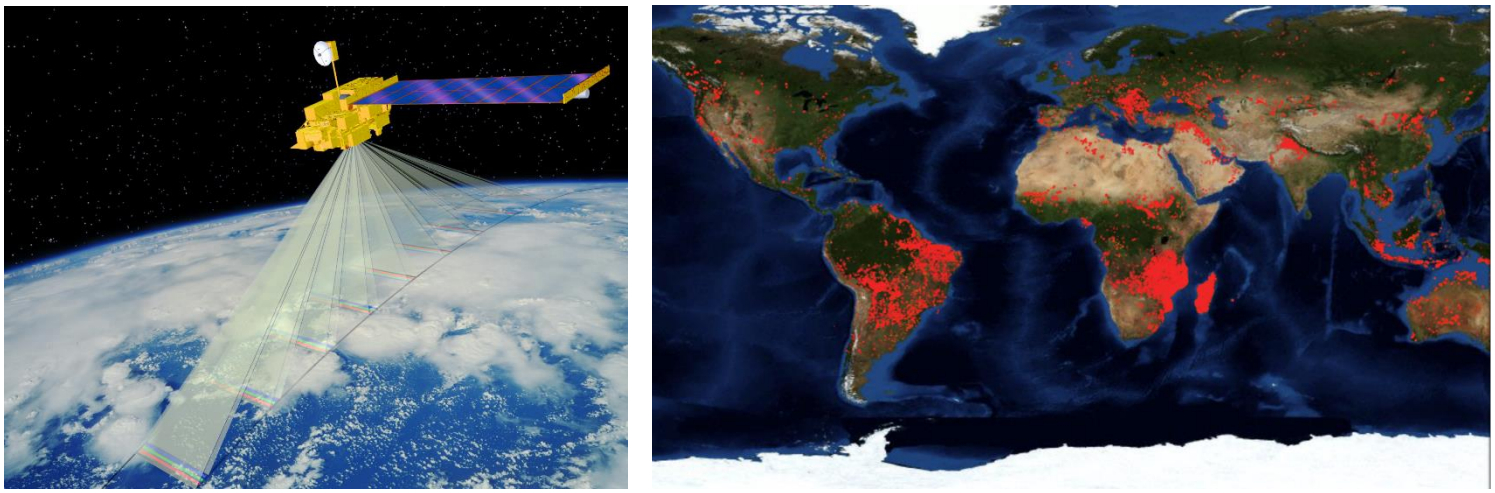

Figure 1. Atmospheric quality, affected by human industry, effluents and pollution, fires and hurricanes and tornadoes are all being monitored in real time by space-based assets to help assess effects and provide agile response for global safety & resource management.

New cities are emerging, established towns are growing and expanding, and many metropolises are merging to become megalopolises around the globe. And urban infrastructures around the world are coping hard to adjust to new pressures including the huge population migration from rural to urban regions, climate change effects, and access to vital resources, all in an effort to sustain and enhance the quality of life of the citizen.[Figure 2]

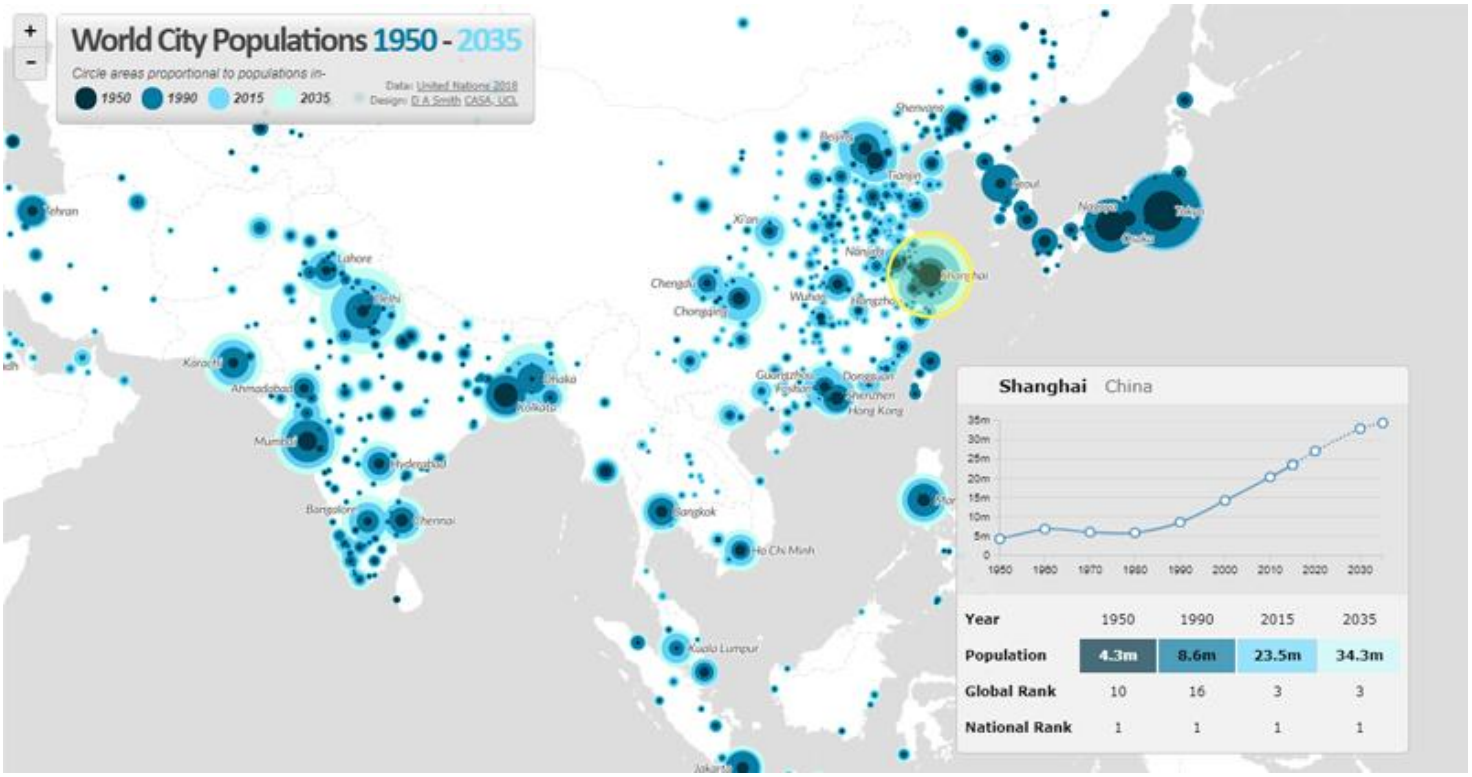

Figure 2. New cities are emerging, established towns are growing and expanding, and many metropolises are merging to become megalopolises around the globe. This growth is already taxing established city management technologies and practices to their limits.

Providing a safe, productive and nurturing environment for the city dweller is the overarching directive and prime aim of every city and city management. Enhancing and safely delivering a range of cradle-to-grave activities to sustain the quality of life of the citizen including incorporating agile, responsive systems for health and welfare, economic opportunities, leisure and safety are all part of the evolving Smart City paradigm. Agile information gathering via sensors in space, sky, and on ground in the Smart City Paradigm allow rapid assessment and response that allow city management to offer better amenities and security for the citizen [Figure 3]

Figure 3. Agile information gathering via sensors in space, sky, and on the ground in the evolved Smart City Paradigm allow rapid assessment and response to dynamic needs that will help city management to offer better amenities and all-round security for the citizen.

By applying lessons learned so far, and using environmentally friendly space technologies, both employed by or being developed in the space community for outer space activities, space systems and practices can be adopted directly or adapted to enhance city life, while also paying attention to 21st century UN Sustainable Development Goals.[Figure 4]

Figure 4. Space technologies and practices are being, and can be adopted directly or adapted to enhance city life, while also paying attention to 21st century UN Sustainable Development Goals to improve the Quality of Life for the City Dweller and visitor alike.[UN]

Specifically, space technologies in current use including energy production and distribution, the scaling of environmental control and life support systems used to support human spaceflight missions may be adapted to accommodate large populations. Atmospheric scrubbing and revitalization, production of potable water and recycling waste water and solids can also be deployed at scale in cities.The International Space Station is a prime example of an Earth orbiting facility that has been operating on clean, renewable solar power, recycling over 90% of water, and revitalizing the atmosphere for the last two decades.[Figure 5]

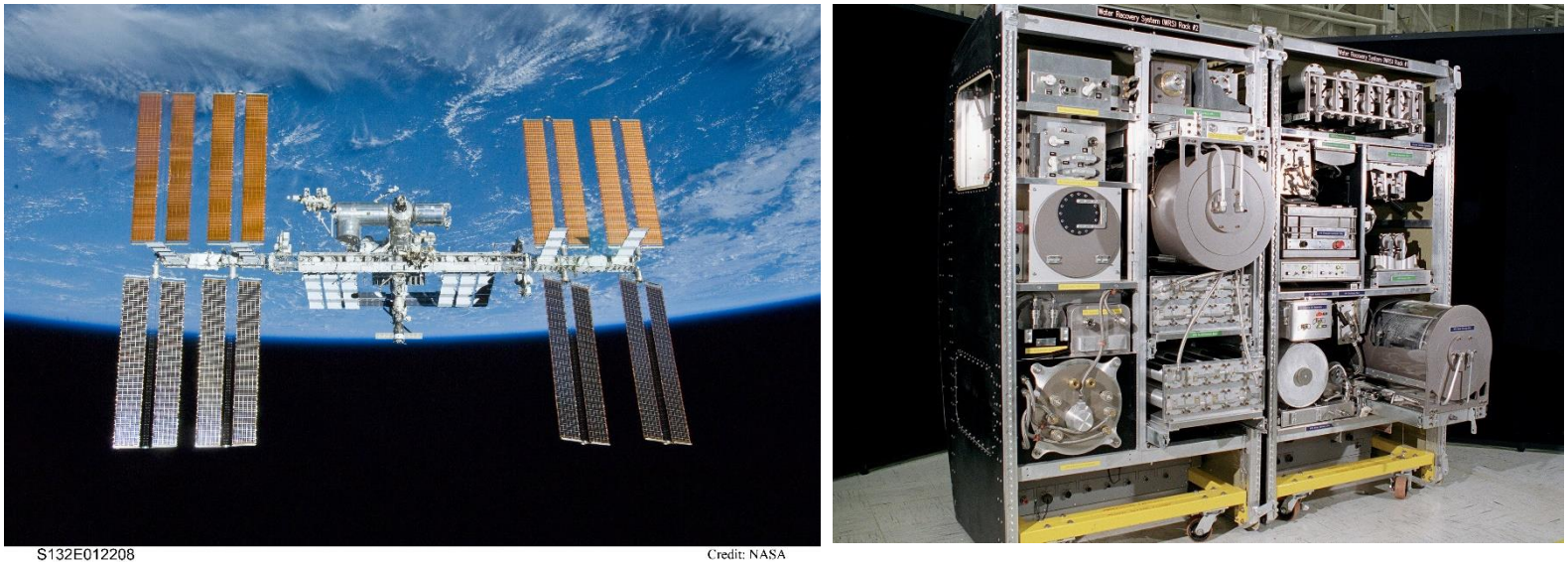

Figure 5. International Space Station is a prime example of a carbon neutral Earth orbiting facility that has been operating on clean, renewable solar power, recycling over 90% of water, and revitalizing the atmosphere for the last two decades.[Credit NASA]

In addition, efficient food production and pollution-free, local and long haul transportation and related autonomous agents and allied robotic technologies coupled with agile 5G+ communication networks that allow Internet of Things(IoT) across a myriad of devices for monitoring and responding to citywide needs like traffic and resource management are all related to spacecraft systems in use or in advanced development stages today.[Figure 6.]

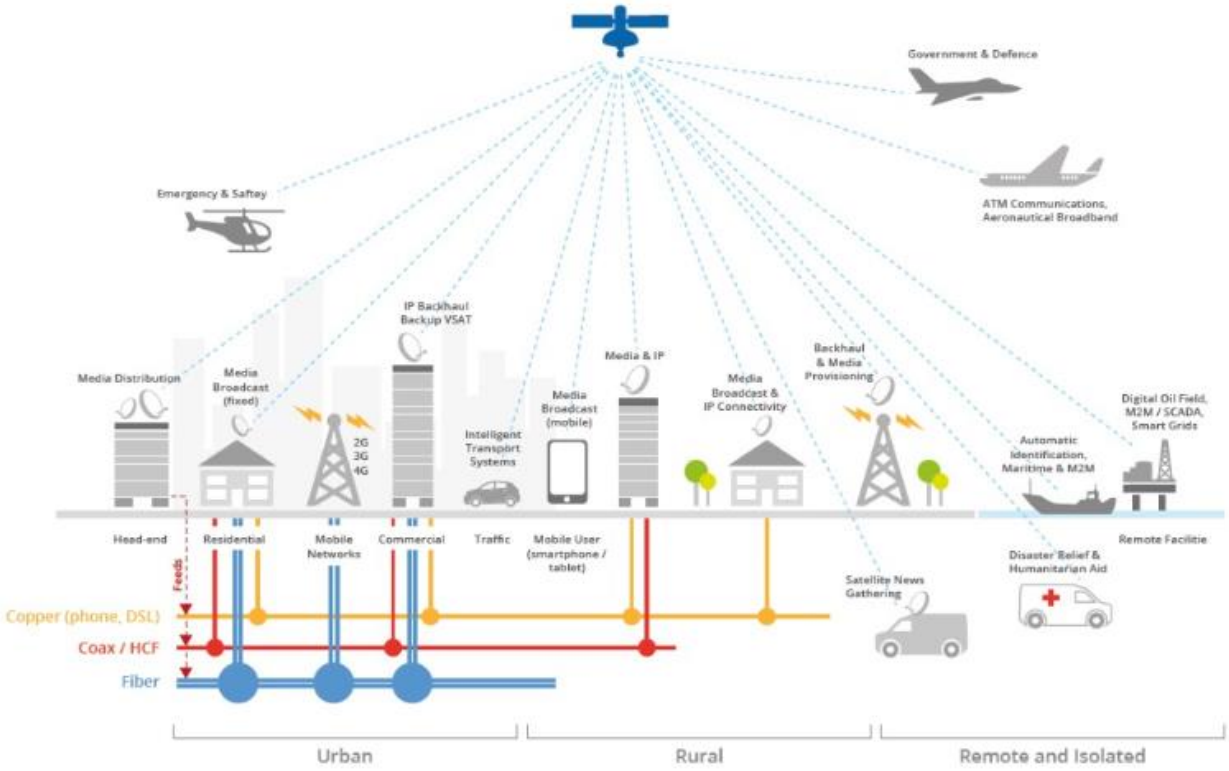

Figure 6. 5G+ communication networks that allow Internet of Things(IoT) across a myriad of devices and robotic systems for monitoring and responding to citywide needs like traffic and resource management. They are all being networked with orbiting satellites and spacecraft systems in use or in advanced development stages today to make the life of the city dweller and management smoother.

This paper presents the potential for improving the quality of life of the city dweller using advanced space and allied technologies.

It is concluded that environmentally friendly space activity and allied technologies can have immense positive impact yet to be realized in city evolution, and that the Smart City paradigm being currently rolled out across the world stand to benefit tremendously from integrating outer space technologies into the deeper layers of city infrastructure.

USC School of Architecture has the most diverse student body among American universities. Following synopses are aspects of potential, progressive developments that are possible in certain world cities by extending the use of space technologies, presented by a diverse group of students from around the globe, pertaining to their city of choice or origin, all of whom sat in the 3-unit Space and City seminar in the Spring of 2019.

II.A solution to Durban floods

With an increase in migration to cities weekly, we witness a sustained stress placed on our Urban communities and a reduced ability to accommodate, protect and sustain local populations. Our increased industrial activities continue to exacerbate issues of climate change and amongst those consequences, specifically in the case of Durban, KwaZulu-Natal, is the growing number of floods in the city as a result of rising sea levels. In 2019 images and clips of the Indian ocean sweeping the commercial strip along the coast of North and South beach swarmed social media. The Durban Port, an integral contributor to the country's economy, was affected most as rising tides swept in pollution at an alarming rate, forcing it to shut down for recovery and maintenance. All together flooding due to sea level rise, in the year 2019 alone, affected the lives of thousands and resulted in over $45million in infrastructural damages. .

The South African National Space Agency continues to conduct research on, how the city can improve its ability to predict and better prepare for damages associated with sea-level rise, amongst other natural disasters? South Africa's efforts to contribute to space technology research, a $7 billion investment per year, have proven crucial and significantly beneficial as a means to address social and economic needs, health, safety and security, as well as innovation and efficiency within the city. Having looked at various precedents in flood management, this project advocates for looking at space, and the systems in place, to begin to draw strategies that inform the ways in which we prepare for and respond to natural disasters such as flooding in Durban, because of sea level rise, in the near future. This project looks to orbiting satellite stations as a fundamental inspiration in encouraging a maximized drone use on earth surface in similar ways regarding shoreline surveillance to help predict, alert and even prevent hazards, both natural and manmade, from affecting populations adversely. These super drones will be often to collect data and alert additional technology systems in place, i.e., barriers at harbor. As part of the intervention, the project also proposes a water barrier bridge at the ports mouth, that's dedicated to controlling tide movement, abnormal water movement as well as bridging the ports newly proposed primary truck route to Transnet shipyards. Together, both these systems in place will contribute to increased port efficiency and a decrease in flood damages and pollution in the affected parts of the city[Figure 7.]

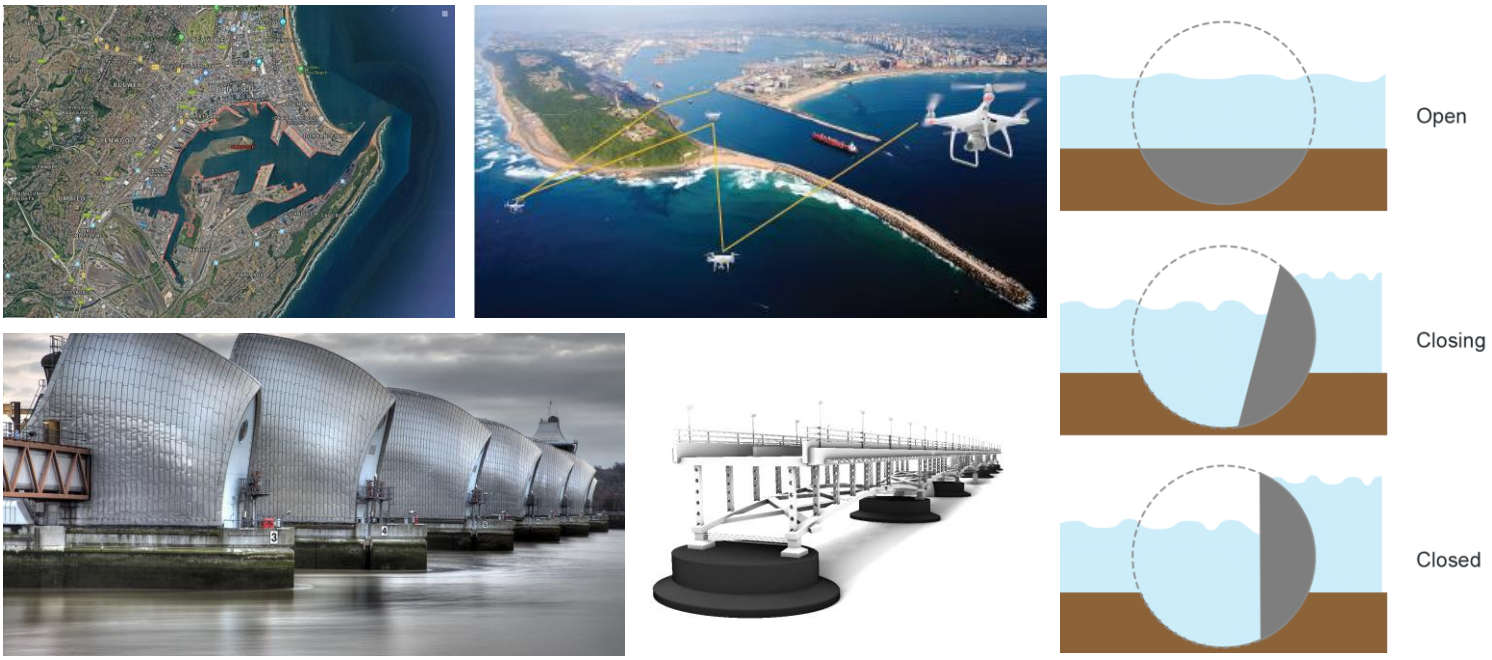

Figure 7. Climate Change and associated Sea level rise affect Durban and its harbor. A bridge to connect the mouth of the harbor and a barrier akin to Thames Barrier is proposed to control tides and flood water. Drones augmented with satellite data will help monitor maritime traffic and provide real time assistance to shipping yard personnel and cargo movement.

A solution to Durban floods

Project Abstract

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The Durban Port, an integral contributor to the countries economy, was affected most as rising tides swept in pollution at an alarming rate, forcing it to shutdown for recovery and maintenance. All together flooding due to sea level rise, in the year 2019 alone, affected the lives of thousands and resulted in over $45million in infrastructural damages.

This project questions, regarding accelerated sea level rise, as a consequence to climate change, is how can the city improve its ability to predict and better prepare for damages associated with sealevel rise, amongst other natural disasters?

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Having looked at various precedents in flood management, this project advocates for looking at space, and the systems in place, to begin to draw strategies that inform the ways in which we prepare for and respond to natural disasters such as flooding in Durban, as a consequence of sea level rise, in the near future.

The South African National Space Agency continues to conduct research on ways in which satelight technology can be used to: protect and monitor wildlife, from poaching,track movement of animals and bird species on the continent throughout the seasons, and improved telecommunication and as well as efficiency of coastline surveillance.

This project looks to orbiting satellite stations as a fundamental inspiration in maximizing drone use on earth surface in similar ways regarding shoreline surveillance to help predict, alert and even prevent hazards, both natural and manmade, from affecting populations adversely. These super drones will be often to collect data and alert additional technology systems in place, ie barriers at harbour. As part of the intervention, the project also proposes a water barrier bridge at the ports mouth, thats dedicated to controlling tide movement, abnormal water movement as well as bridging the ports newly proposed primary truck route to Transet shipyards. Togeher, both these systems in place will contribute to increased port efficientcy and a decrease in flood damages and pollution in the affected parts of the city.

III.Underground Infrastructure to Preserve Historical Casablanca

This project seeks to explore the potential of advanced modes of technology to develop an underground transportation system and infrastructure for the city of Casablanca in Morocco. The purpose is to create an 'invisible' layer of city infrastructure using advanced space technologies that will not disrupt the city's existing conditions as well as to preserve and enhance cultural traditions and customs.

Casablanca, as well as all other cities in Morocco, have deep and rich cultural heritage of customs and rituals, and powerful connections to history in terms of craft, architecture, methods of construction.[Figure 8] The concept of this project is to create a scheme that facilitates swift and clean transportation all over the country, and to eliminate the current traffic congestion dilemma, especially in Casablanca, the densest and busiest city in the country that can only get more difficult in the years to come as the population is expected to climb from the current 37million to 48 million by 2070.

Casablanca, including the seaport, is the heart of Moroccan economy,[Figure 9] and adding value to it through underground tubes that facilitate autonomous vehicle movement as well as advanced utilities could achieve great results. No gas emission, no surface traffic, no noise, time saving, and most importantly, preserving the historic cityscape heritage, are among the priorities and highlights of this project.

The challenge would be to have all facilities, factories warehouse and offices underground to leave the upper surface clean and uncongested, to enhance pedestrian access; walkable, calm and free from any pollution.

Deep Learning algorithms within the city management system will study and learn from human space activities in and around Casablanca, and allied mature technologies such as robotics and artificial intelligence will be key to monitoring and timely reporting of city functions that will allow city management to achieve optimum results; the way astronauts generate clean power to work inside a spaceship with robust environmental control systems that provide clean air and water while recycling and managing waste and how their scheduling of activities are monitored and assisted by robotic agents was a driving force in envisioning this project as a similar system where humans are in control of their mission for maximum productivity, comfort and leisure, in harmony with the temperate climate and weather, and without overstressing, overloading or harming the environment. This added layer would be a new city that operates every day to offer optimum comfort for the citizen and the tourist alike, providing new amenities and satisfying living experiences.

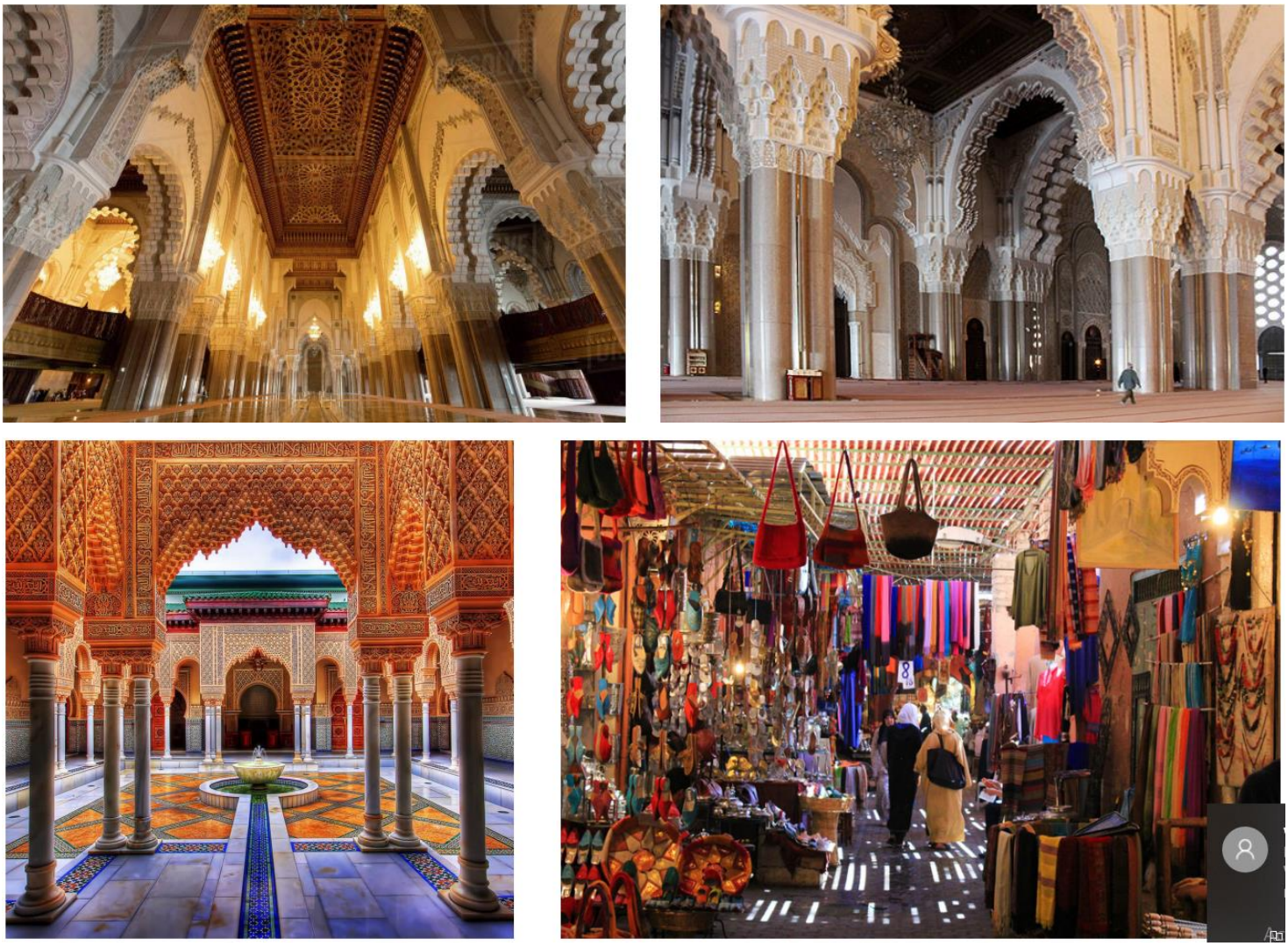


Figure 8. Casablanca, as well as all other cities in Morocco, have deep and rich cultural heritage of customs and rituals, and powerful connections to history in terms of arts and crafts, architecture, and diverse methods of construction.

Figure 9. The Hassan II Mosque is a focal point near the seaport that is central to the economy of Casablana and Morocco..

Figure 10. Underground Dwellings are extremely energy efficient. An example in Bhalil Village, Morocco

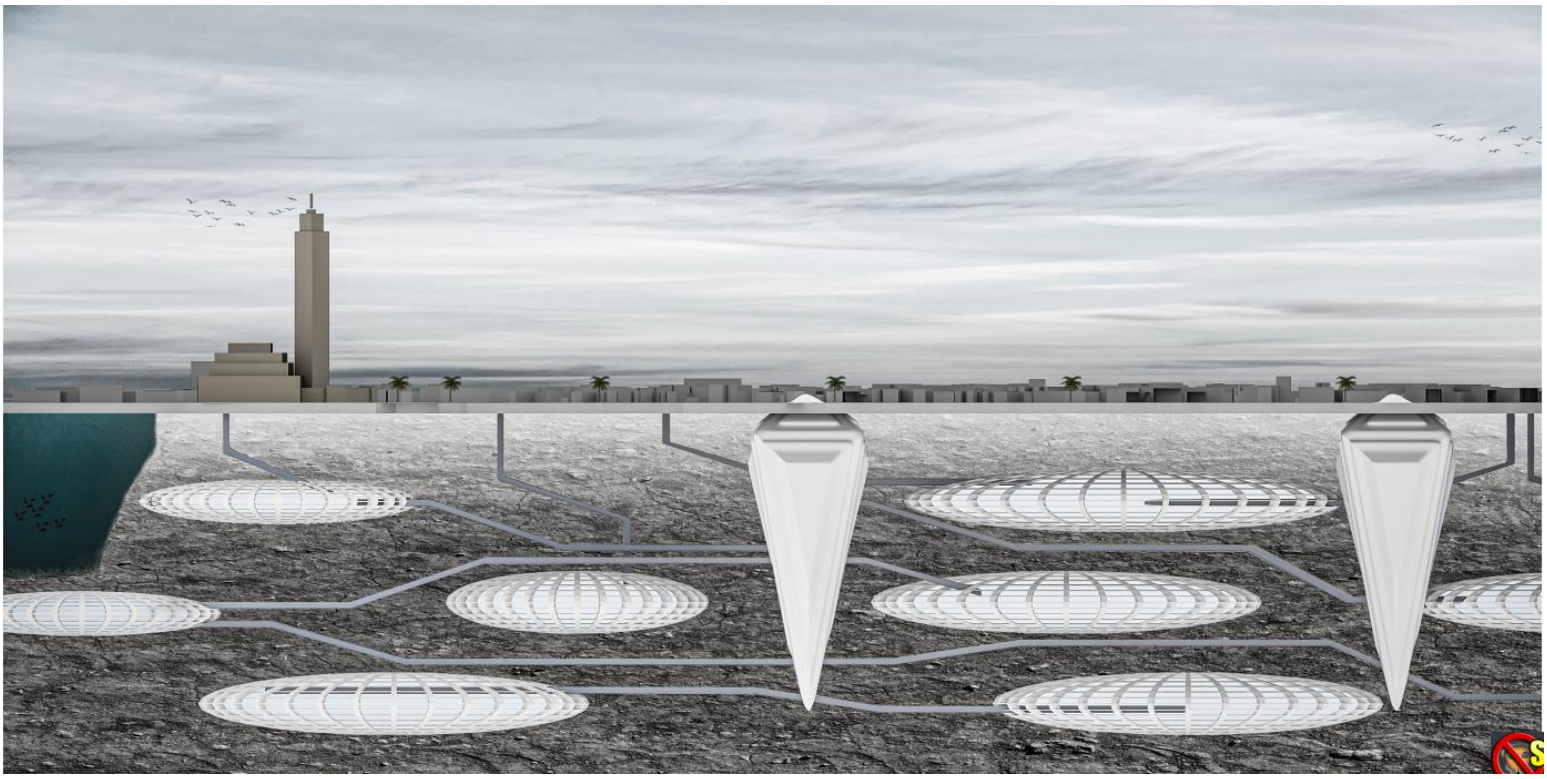


Figure 11. Concept for Casablanca Seaport Underground Transportation, Factories, Warehouses and Utilities linking the whole city will provide the city dweller with more amenities while preserving and maintaining the vital culture and character of the historic cityscape.

Figure 12. Morocco's heritage is of extreme importance to the citizens and the government. It has a long history of centuries. A new change to the system shall not disturb the well preserved heritage and its value. For such purpose, this project is seeking to explore alternatives to expand the use of roadways and occupied ground through underground infrastructure. Space technology can create new modes of future transportation and create a new layer of industry and commerce underground that will help reduce traffic, gas emission, noise and pollution without the need to disrupt the cultural aspects of Morocco, and especially the historic cityscape of Casablanca.

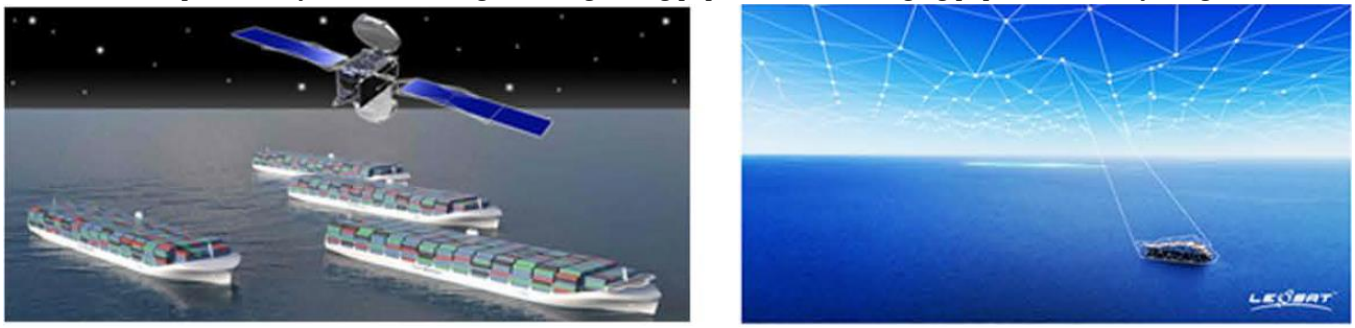
IV. Yangtze River Delta & The Future of Shanghai

Rising sea levels across the globe are adversely affecting coastal cities. Global warming is responsible for this gradual process that is devouring highly prized coastal properties and shrinking accessible land area just as urban populations are growing. The main problem of sea-level rise is that the ecosystem in coastal cities is being damaged, and changes in the climate and extreme weather is creating havoc in densely populated cities and regions around the world.

Shanghai is one of the world's largest seaports and a major industrial and commercial center of China. The city is located at the mouth of the Yangtze River, which is one of the longest rivers in the world. The banks of the Yangtze host many cities along its run and has a tremendous impact on China's economy.

Due to the sea-level rise, the land area will be decreased, especially around Shanghai. To deal with the issue, seashore, as well as advanced underground infrastructure developments, are proposed. The study presents the potential for improving the quality of life of the city dweller in Shanghai. By vastly increasing the potential underground space which can house hotels, shopping malls and markets, parks and recreation facilities, as well as subway-metro, and parking garages.

Using the natural tidal action of the sea- underwater turbines are suggested for augmenting power generation that is needed to support the city. Yangtze River flows through part of the city and power generated from the Yangtze River is considered. The potential alternative power generation facilities include windmills on the ocean surface, underwater turbine generators, and the transportation and utility tunnels under the river. Orbiting satellites can be used to steer increasing barge traffic autonomously and efficiently as are cargo ships servicing the harbor.[Figure 13] All these proposed infrastructure developments employ advanced space and clean energy technologies and will help to increase urban productivity while absorbing the fast-growing population and managing population density. [Figure 14]



F*igure 13. Orbiting satellites used to steer increasing barge traffic autonomously &efficiently, as are cargo ships servicing the harbor*

Figure 14. Shanghai can build underground, and tunnels can ease traffic, while underwater turbines can augment city power needs

ARCH 599-SPACE AND CITY
INSTRUCTOR: MADHU THANGAVELU
STUDENT: XINGBAI ZHANG

The city is located on the coast of the East China Sea between the mouth of the Yangtze River (Chang Jiang) to the north and the bay of Hangzhou to the south. The municipality's area includes the city itself, surrounding suburbs, and an agricultural hinterland. Shanghai is China's most-populous city, and the municipality is its most-populous urban area.[1]

Abstract

Rising sea levels across the globe are adversely affecting coastal cities. Global warming is responsible for this gradual process that is devouring highly priced coastal properties and shrinking accessible land area just as urban populations are growing. The main problem of sea-level rise is that the ecosystem in coastal cities is being damaged, and changes in the climate and extreme weather is creating havoc in densely populated cities around the world. Shanghai is one of the world's largest seaports and a major industrial and commercial center of China. The city is located at the mouth of the Yangtze River, which is one of the longest rivers in the world. The banks of the Yangtze host many cities along its run and has a tremendous impact on China's economy. Due to the sea-level rise, the land area will be decreased, especially around Shanghai. To deal with the issue, seashore, as well as advanced underground infrastructure developments, are proposed. The study presents the potential for improving the quality of life of the city dweller in Shanghai. By vastly increasing the potential underground space which can house hotels, shopping malls and markets, parks and recreation facilities, as well as subways-metro, and parking garages. Using the natural tidal action of the sea- underwater turbines are suggested for augmenting power generation that is needed to support the city. Yangtze River flows through part of the city and power generated from the Yangtze River is considered. The potential alternative power generation facilities include windmills on the ocean surface, underwater turbine generators, and the transportation and utility tunnels under the river. All these proposed infrastructure developments employ advanced space and clean energy technologies and will help to increase urban productivity while absorbing the fast-growing population and managing population density.

The Yangtze River now demarcates the provinces constituting South China. The Yangtze also was the focus of many of the Imperialist incursions into China in the 19th century and the first half of the 20th, with Shanghai at the river's mouth becoming the main foreign commercial base. Since 1950 the river and its basin have been the focus of much of China's economic modernization.[2]

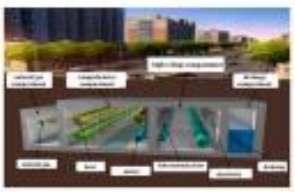
Underwater Turbine Generator

Autonomous shipping navigation using advanced satellite systems

Windmills Over the Ocean

Robot Server

Robot Cleaner



Underground Utility Tunnel

Underwater Tunnel

V.Local Produce and Waste Management in Los Angeles

Even today, the consequences associated with how we produce, transport, and manage our food, water, and waste can be clearly seen in our streets, oceans, and continuously expanding landfills; and less clearly seen in the increasing CO2 levels that effect the air we breathe. As our cities continue to densify, how we produce and dispose of the food, water, and products we consume will play an integral role in the management of a city. Using Los Angeles as a case study, this research aims to integrate new technologies into a plan to improve accessibility and sustainability in the areas of food, water, and waste management. By investing in new technologies and integrating them into an underground infrastructure will increase our chances of reducing our carbon footprint. [Figure 15] The following proposal focuses on various emerging technologies (originating from space research and sustainability research) that can be implemented to improve our 2050 sustainability goals in Los Angeles. Water accessibility is a particularly large issue for Los Angeles, drawing 2/3 of our water from sources outside of Los Angeles. Investing in desalination and water recycling plants can reduce our need for the purchase of water from other sources and the infrastructure needed to pipe it to Los Angeles. The agricultural industry in California is large, taking 40% of the potable water. While we need these industries, we need to invest in more efficient means of generating them. Moving some agricultural farms underground using vertical farms will reduce the water need, eliminate the need for pesticides, and reduce the CO2 emissions generated from various agricultural processing equipment and transportation. Finally, disposing and managing the waste we consume is essential for a growing city like Los Angeles. We have a finite amount of space and using that precious space on landfills is inefficient. We need to invest in new ways of sorting for recycling and improved means of reusing waste through robotics, supercritical water oxidation, and waste to energy processes. By looking forward to future technologies we can limit the ecological footprint that humans generate while also increasing a city's capacity by reducing the need for large scale landfills and providing for those inhabitants with better means of water and food production.

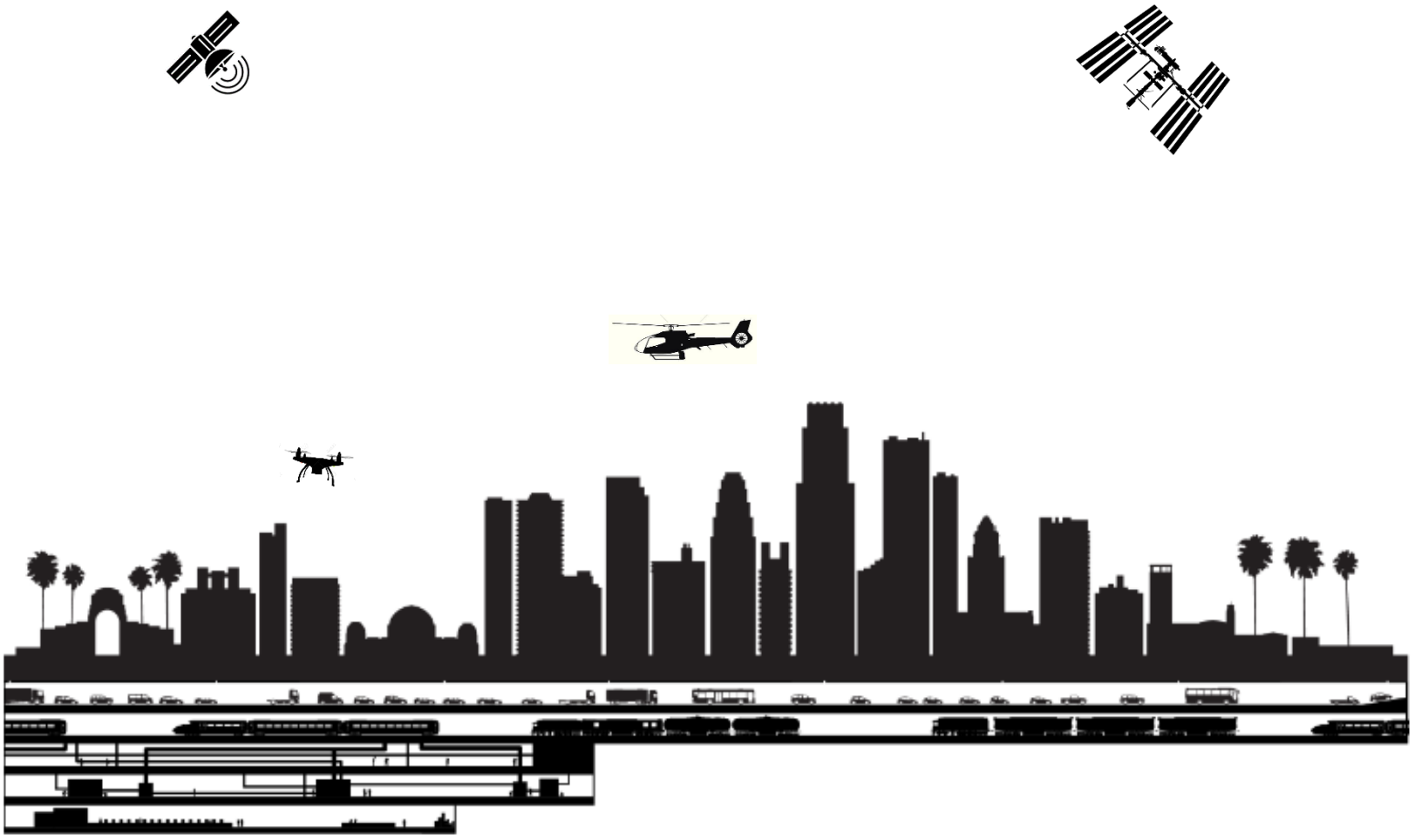


Figure 15. Several miles of abandoned underground tunnels exist in Los Angeles. By investing in new technologies and integrating them into an underground infrastructure, Los Angeles can increase our chances of reducing our carbon footprint. Surface freeway traffic congestion can be moderated or eliminated, below-ground vertical farming with efficient electric LED lighting for local food produce can reduce logistics, desalination and waste treatment as well as some factories and warehousing can all go underground. Satellites are already "keeping an eye"and reporting air quality, farming and traffic. And drones aided by GPS are helping to monitor activities for better city management and to plan city future. Advanced sensors already assist metering of utilities, and robotics can be employed for sorting and recycling and waste management. Human spaceflight technologies like water recycling, efficient lighting &environmental control & life support (ECLSS)can help significantly to bring life and habitation to the LA underground.

CLEAN LA

Local Produce and Waste Management in Los Angeles

ABSTRACT: LOCAL PRODUCE AND WASTE MANAGEMENT IN LOS ANGELES

Even today, the consequences associated with how we produce, transport, and manage our food, water, and waste can be clearly seen in our streets, oceans, and continuously expanding landfills; and less clearly seen in the increasing CO_2 levels that affect the air we breathe. As our cities continue to densify, how we produce and dispose of the food, water, and products we consume will play an integral role in the management of a city. Using Los Angeles as a case study, this research aims to integrate new technologies into a plan to improve accessibility and sustainability in the areas of food, water, and waste management. By investing in new technologies and integrating them into an underground infrastructure will increase our chances of reducing our carbon footprint. The following proposal focuses on various emerging technologies (originating from space research and sustainability research) that can be implemented to improve our 2050 sustainability goals in Los Angeles.

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By looking forward to future technologies we can limit the ecological footprint that humans generate while also increasing a city's capacity by reducing the need for large scale landfills and providing for those inhabitants with better means of water and food production.

Water

Desalination Plant

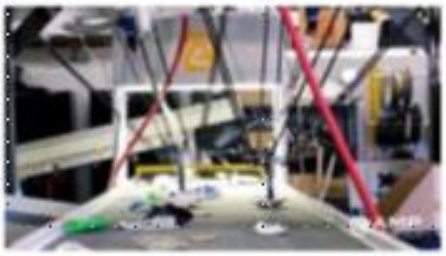
Water Recycling

Food

Vertical Farming

Solein - Solar Foods

Waste Management



AMP Robotics - Automated Recyling

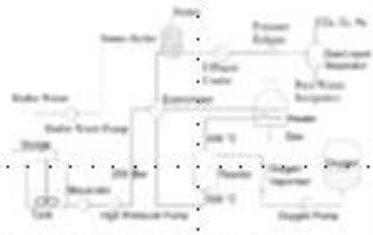
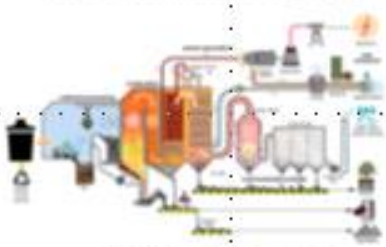


Figure 2: Principal flow sheet of the Aqua Critox® process.

Supercritical Water Oxidation



Waste to Energy Plants

VI. New Delhi : The Yamuna Urbanscape 2050 Project

New Delhi, the capital city of India, is situated along the banks of the Yamuna river. Like other metropolises around the globe, the city is growing rapidly to accommodate a large migration of people from surrounding rural areas. The garden city masterplan, laid out by Lutyens and Baker between 1912-1930. is now being revisited for accommodating the growing population and associated 21st century infrastructure needs. The Yamuna Urbanscape 2050 project focuses on the dire need for sustainable interventions in the urban design realm. India is home to many rivers and Yamuna is one of its longest rivers. The stretch that lies in New Delhi is considered to be one of the most polluted parts of the river and needs immediate remediation to curb environmental degradation. The factories around it have contributed heavily to environmental contamination and remain to be a part of the banks. Farms have seen a dip in the yield, aquatic life has been affected and the river is all but a dumping terrain for waste. The placemaking of the new riverfront, rehabilitation of the river, rejuvenating the soil for agriculture, and creating a sustainable, accessible community form the basis of this project. The major focus with respect to the city in 2050 is to mitigate the rapid urbanization with predictions of 70% of the total population living in urban areas. The sectors identified that lie in the scope of this project and need intervention include farming, river, riverfront, housing, and transportation among others. To achieve this, a conceptual manifestation has been proposed as to how we can tackle the anticipated needs of the future. The river presents number of opportunities that can change its current singular use. The decontamination of the river by the use of water wheel waste collectors. These, with the help of a barrage, can help to manage waste in certain parts of the river. The banks would harbor vertical urban farms in consortium with the conventional farmland. One side of the riverbank near the systems would be allocated for waste management. The clean water then flows towards the city where a riverfront is used as public spaces for the community. The super-tall skyscrapers congregate near the river. The land near the river can be utilized above and below grade for maximum utilization of parcel of land. Each parcel of land will be a self-sustaining unit starting from the top with vertical farms, housing, commercial and public spaces on ground and offices and/or industrial units below ground.[Figure 16] Transportation plays a key role in running the new ecosystem of infrastructure optimally. The supertall structures with storeys on the top level will be inter-connected while the underground infrastructure will have its own network of transportation. Most of the surface terrain will be free from the built environment, and luxurious green public spaces will provide abundant “lungs” for the city. Connected public transport will ensure maximum access to most areas and help curb traffic congestions which is one of the most crippling factors of the National Capital. The whole new ecosystem aims to provide a roadmap for development focused on optimum utilization of river as the epicenter of activity and life. A holistic approach towards urban sustainability, waste management and bringing back life to the river. Space technologies including solar power, water recycling, intensive closed-loop crop cultivation together with underground factories and clean, electric mass transit and agile satellite and drone-based city traffic and critical infrastructure management using advanced robots and invisible sensors coupled to artificial intelligence agents will help New Delhi thrive and bloom in the 21st century as the Garden City that the city planners and original architects envisioned.

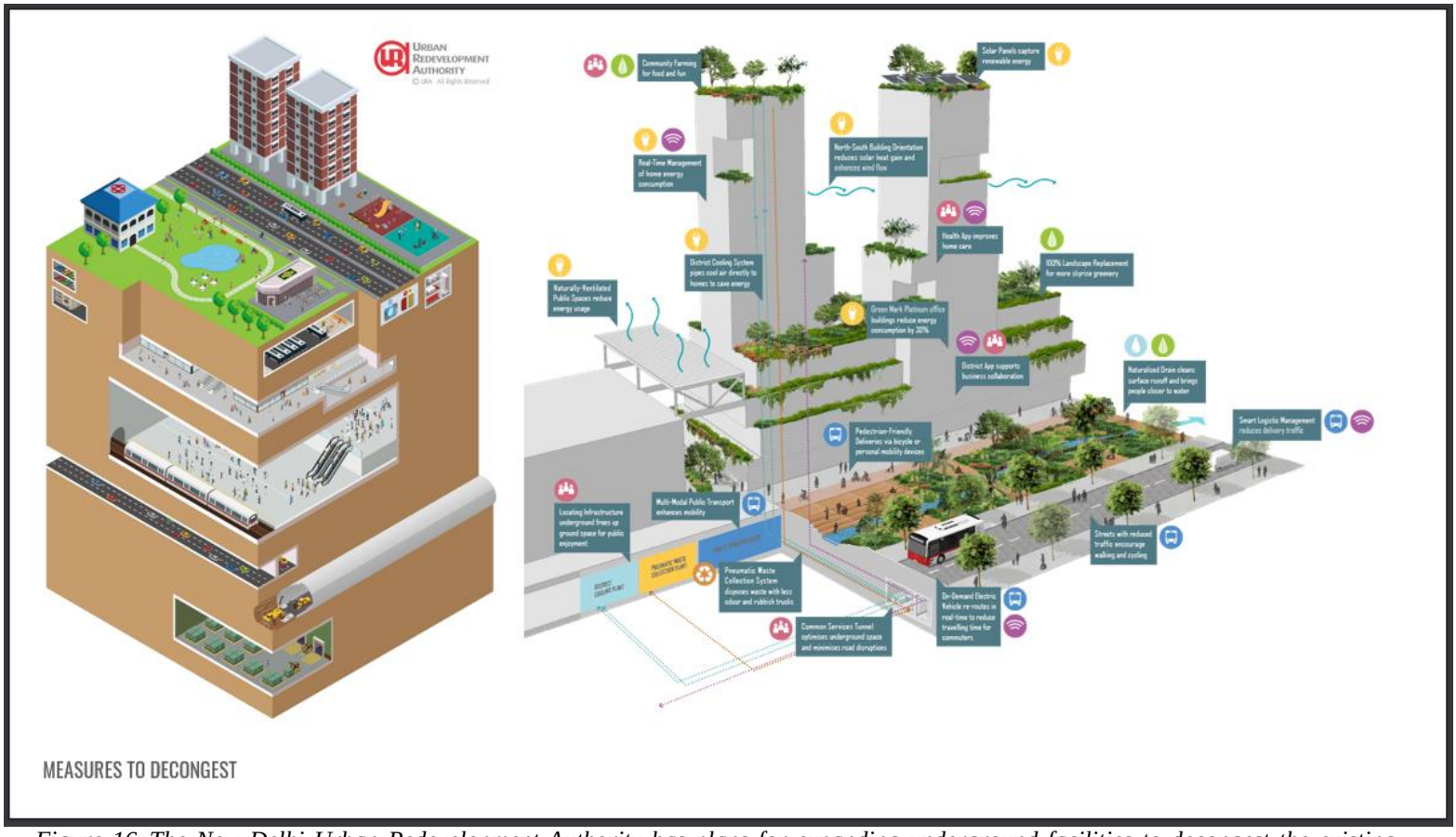
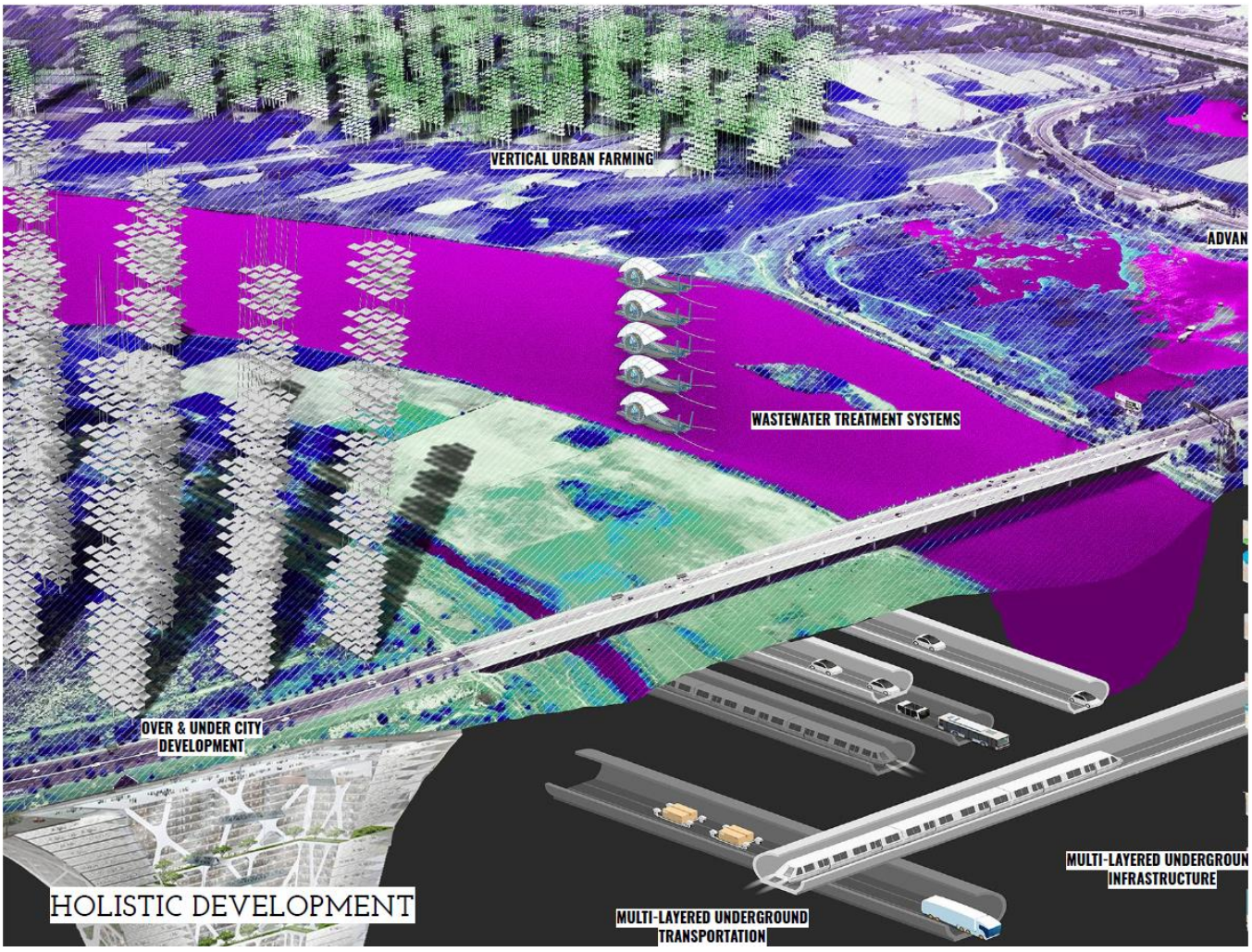
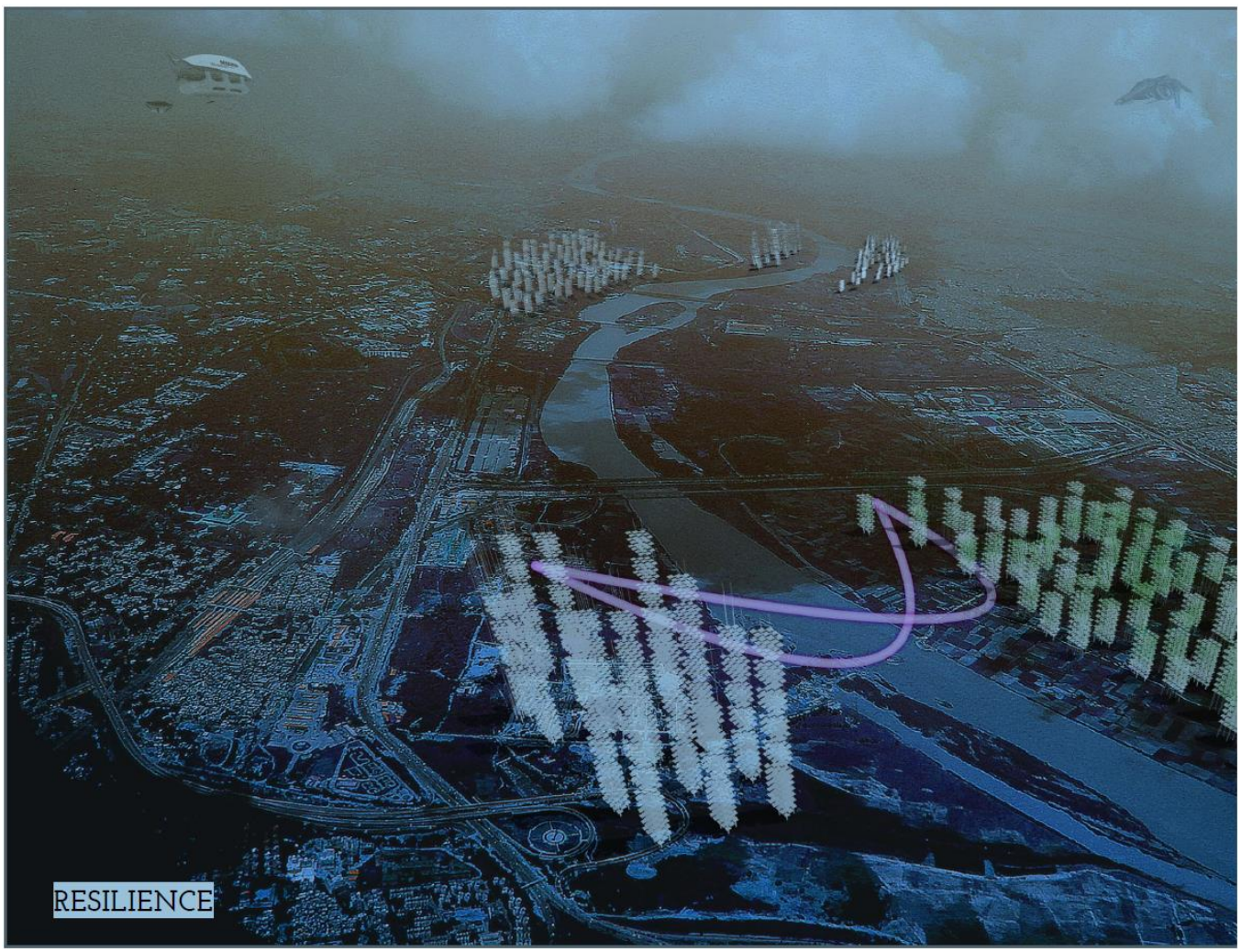


Figure 16..The New Delhi Urban Redevelopment Authority has plans for expanding underground facilities to decongest the existing surface cityscape to absorb and manage a burgeoning population influx from surrounding rural areas. Space technologies can help.

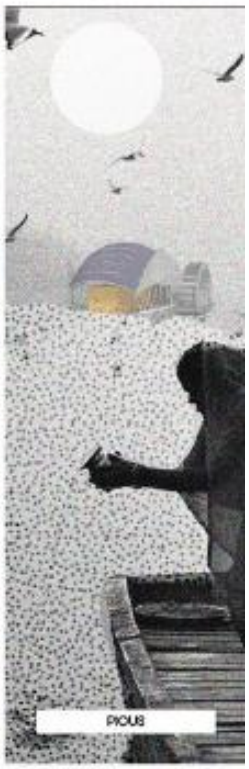

VERTICAL URBAN FARMING
ADVAN
WASTEWATER TREATMENT SYSTEMS
OVER & UNDER CITY DEVELOPMENT
MULTI-LAYERED UNDERGROUN INFRASTRUCTURE
HOLISTIC DEVELOPMENT
MULTI-LAYERED UNDERGROUND TRANSPORTATION

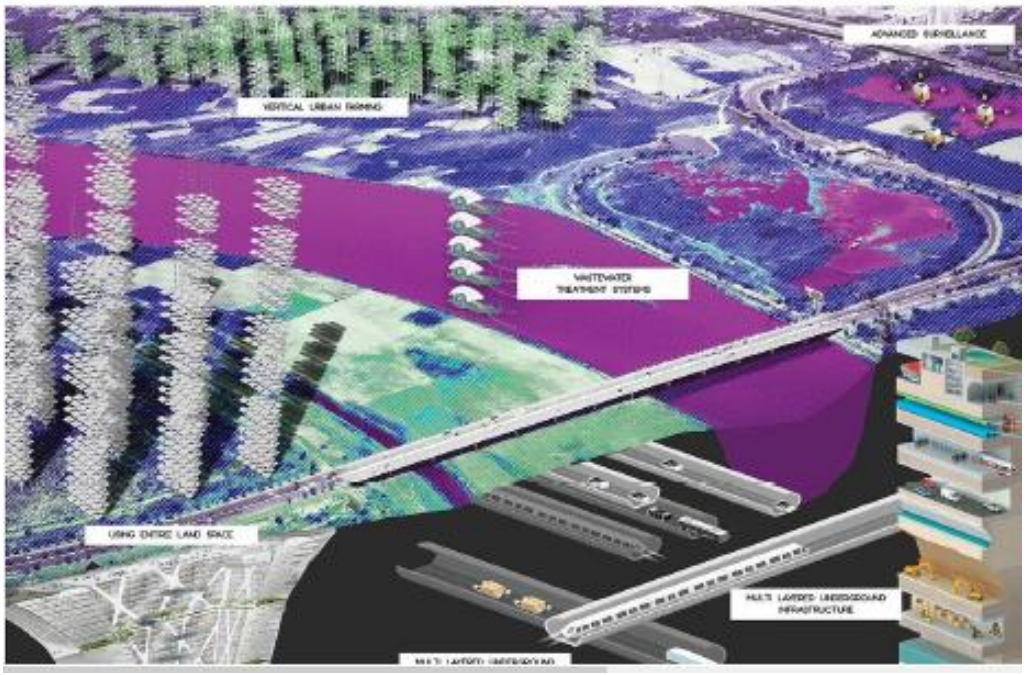

RESILIENCE

YAMUNA URBANSCAPE [2050]

The Yamuna Urbanscape 2050 project focuses on the dire need for environmentally sensitive interventions in the development of and around the river. India is home to many rivers and Yamuna is one of its longest rivers. The stretch that lies in New Delhi is considered to be one of the most polluted parts of the river and needs immediate remediation to curb further environmental degradation. The factories around it have contributed heavily to environmental contamination. Farms have seen a dip in the yield, aquatic life has been affected and the river has become a channel for waste discharge.

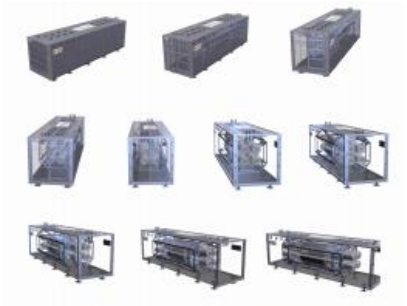
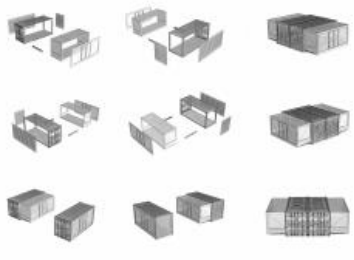
The conjunctive placemaking of the new riverfront, rehabilitation of the river, rejuvenation of soil for agriculture, and creating a sustainable, accessible community form the basis of this project. The major focus with respect to the city in 2050 is to mitigate the rapid urbanization with predictions of 70% of the total population living in urban areas. The sectors identified that lie in the scope of this project and need intervention include **farming, river, riverfront, housing, and transportation**. To achieve this, a conceptual manifestation has been proposed as to how we can tackle the anticipated needs of the future.

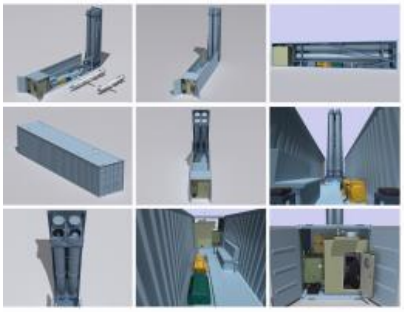
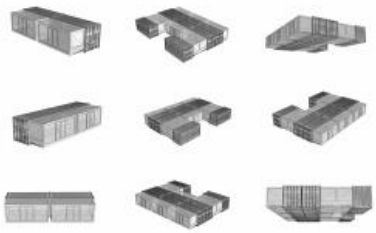
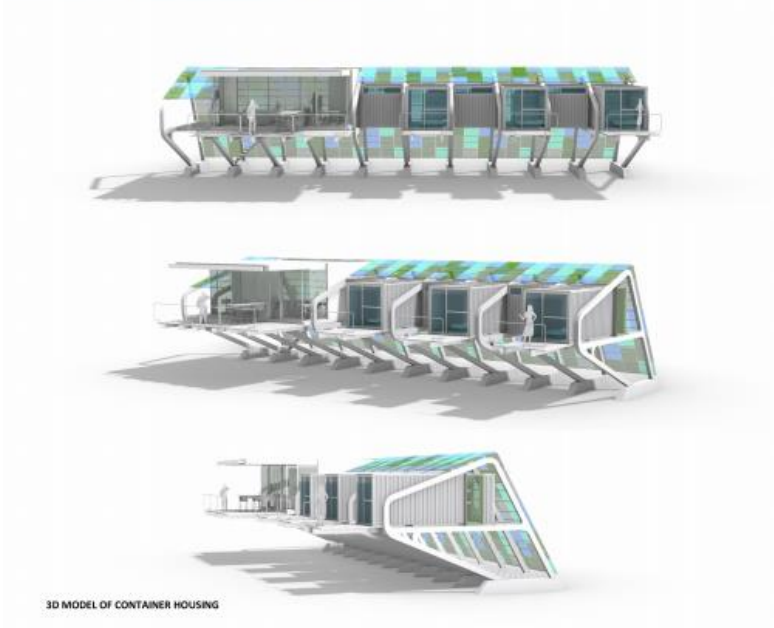
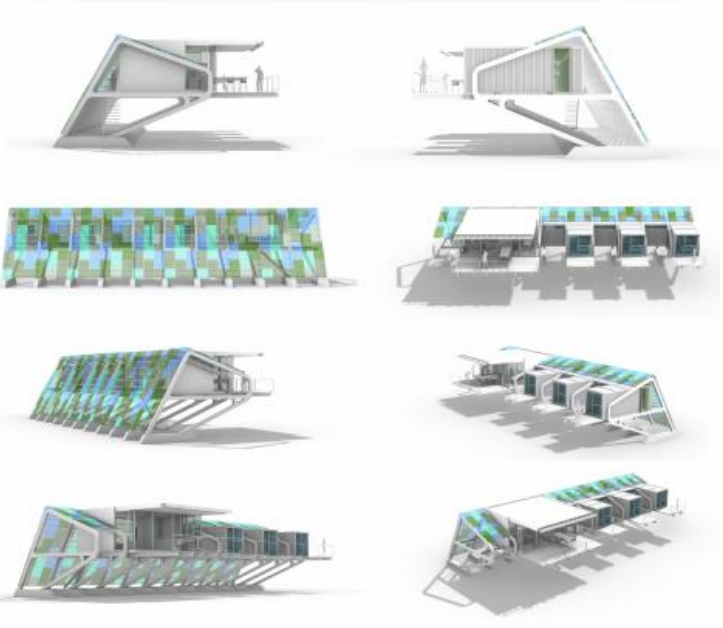
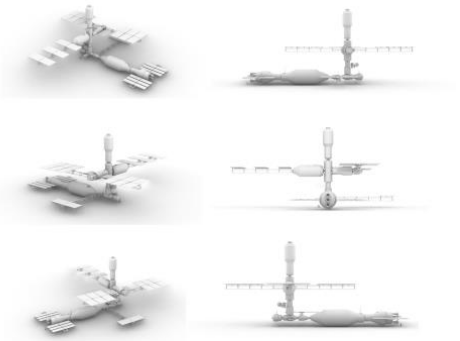
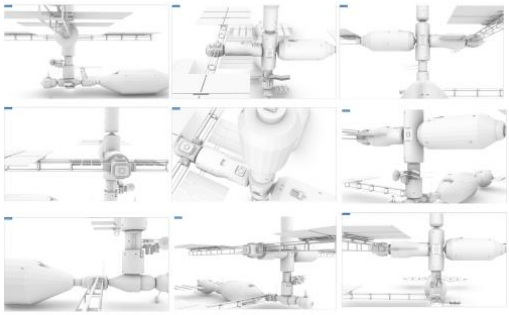
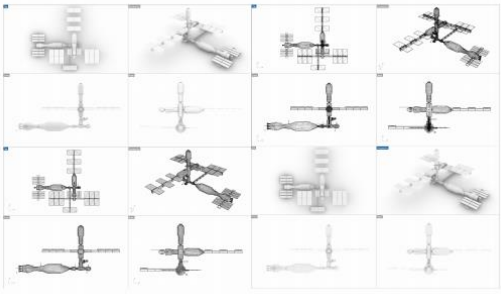
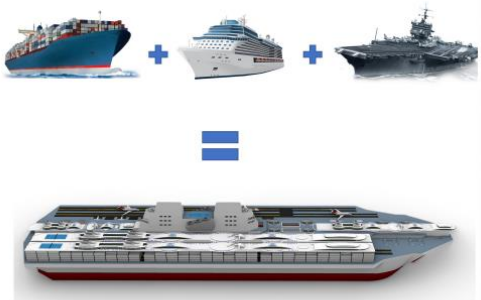


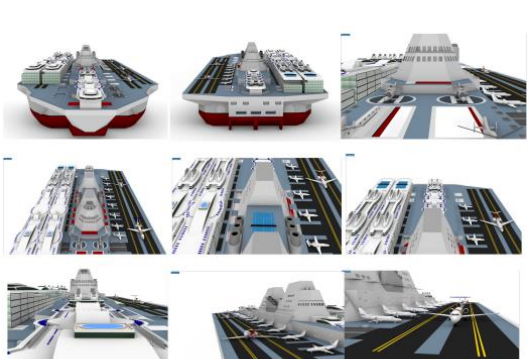


VII.Container Ship Habitats

Increasing human population and overcrowding in coastal cities, coupled with climate change sea level rise, and extreme weather conditions that is resulting in a slow but steady loss of habitable shoreline, several visions for the ocean city habitats have been proposed. Climate Change effects have already affected millions of people around the globe, including some of the densely populated Asian coastal countries like Japan, Indonesia and Philippines, as well as the islands around the globe such as the Maldives, French Polynesia islands, Federal States of Micronesia, Marshall Islands, Palau Islands and many other island nations in remote parts of our globe, threatening them to become uninhabitable. Extreme weather conditions like fires, hurricanes, earthquakes, volcanic eruptions and other deep ocean landslides have caused massive tsunamis, devastating many countries, killing several hundred thousand of people in the recent past. We can expect these natural phenomena to continue to be a threat to civilization around the world. The vision for Container Ship Habitat project is based on the concept of shoreline and ocean settlements to deal with the continued migration of human population from rural and remote areas to urban centers, especially in coastal regions. Container Ship Habitat project could be one affordable solution for future city development to safely accommodate a rapidly growing city population using recycled shipping containers to build habitats and integrating them into the hulls of large, retired commercial shipping vessels. Container Ship Habitat projects could be berthed near the shorelines of many cities and islands around the globe. This Container Ship Habitat proposal offers a safe environment where people can live, work and relax remotely on massive Container Ships. A vision for permanent human habitation is proposed, where humanity can expand their livable area into the ocean. Those habitats would eventually become permanent places to safely live and work for millions of people throughout the year while protecting them during drastic climate change effects as well. This idea would save millions of people's lives annually and would create a different environment for everyone, who are seriously thinking about the value of human lives. It would be a great step towards humanity, that every human life matter and their lives should be saved. In this matter, Container Ship Habitat would be a great solution for the climate change crisis. The Container Ship Habitats proposal would create enormous opportunities for people around the globe, which would eventually lead to ocean colonization and expansion of the livable area which has not yet been fully studied. The knowledge earned from ocean colonization would be applicable to space settlements as well. Modular integration of elements is comparable to how space stations are built. Nuclear power used in aircraft carriers today can provide uninterrupted power while solar photovoltaics and high power density, high capacity batteries like Tesla is clearly the economic option. Global satellite communication would allow these Container Ship habitats to be berthed anywhere in the world and could also support disaster relief or medical missions like the Mercy ships as and when needed. They could also support themselves economically through ocean farming and caring for the oceans.The ocean might be easier to conquer than space, thus the lessons learned from the former might be a great foundation for the latter.[Figure 17]





3D MODEL OF CONTAINER HOUSING



SPACE STATION 3D MODEL




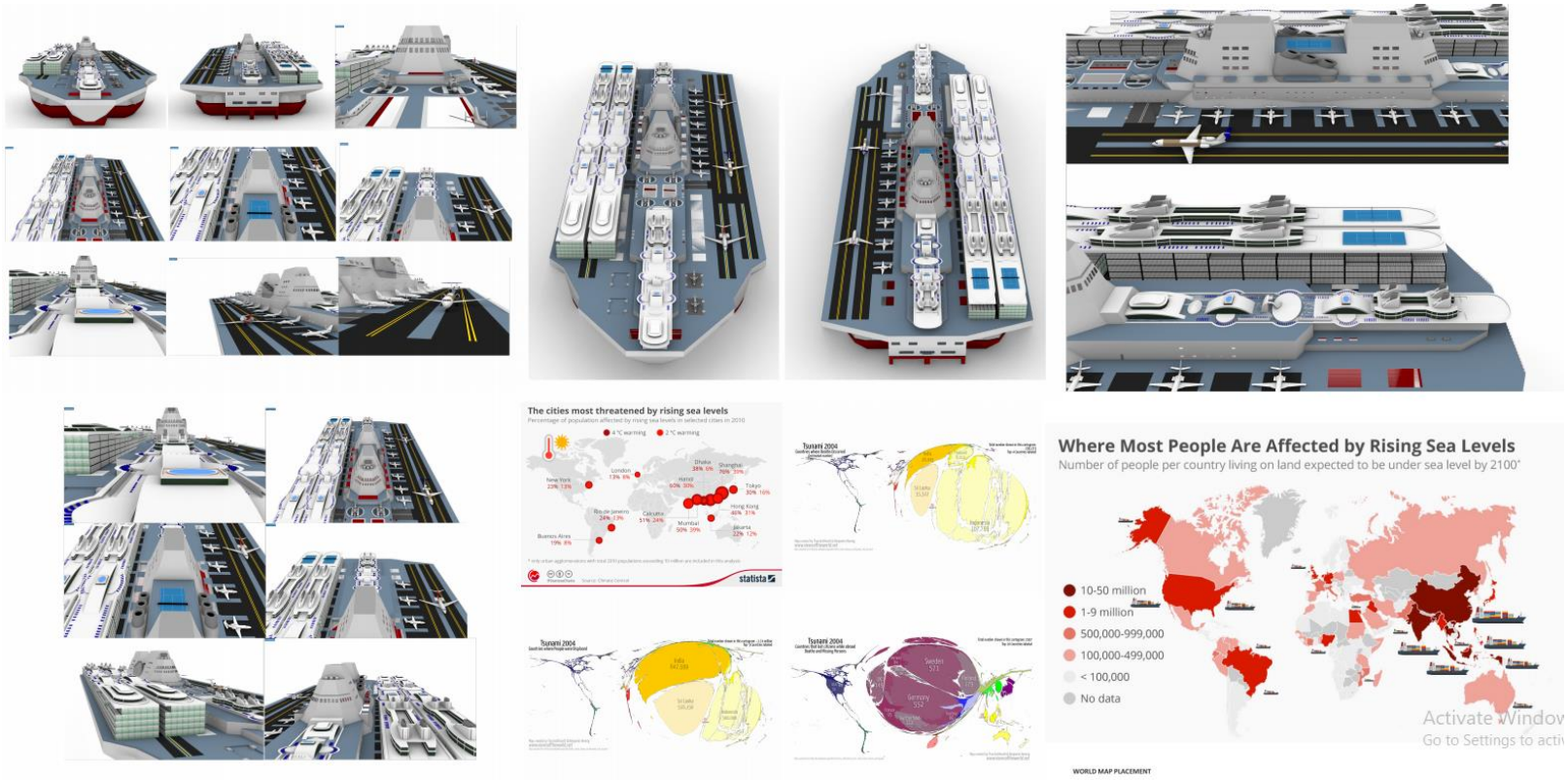


Figure 17. The Container Ship Habitats proposal would create enormous opportunities for people around the globe, which would eventually lead to ocean colonization and expansion of the habitable area which has not yet been fully studied. The knowledge earned from ocean colonization would be applicable to space settlements as well. Modular integration of elements is comparable to how space stations are built. Nuclear power used in aircraft carriers today can provide uninterrupted power while solar photovoltaics and high power density, high capacity batteries like Tesla power walls is clearly the economic option. Global satellite communication would allow these Container Ship habitats to be berthed anywhere in the world, and could also support disaster relief or medical missions like the Mercy ships as and when needed. They could also support themselves economically through ocean farming and caring for the oceans.

VIII.Conclusion

Space technology is already in wide use around the globe. From powering our homes with solar photovoltaics to modular housing and robotics, applications like telemedicine and remote online learning are all aided by advances in space technology. Using human spaceflight principles and adapting life support technologies, it will be possible to increase the urban population density by building habitable, serviceable underground infrastructure. Underground structures are also very energy efficient because of stable ambient temperature and by virtue of not having any surface exposed to the elements and the seasons. Such infrastructure is safe from dynamic surface phenomena and the ravages of climate change and extreme weather like hurricanes, tornadoes, flooding and fires. Properly built and serviced underground infrastructure are also less prone to damage from earthquakes. Mega tall structures already have several floors below ground and advances in tunneling and boring technologies allow extensive critical infrastructure emplacement below ground without the hassles of trenching and for a fraction of the excavation otherwise needed. Advances in efficient HVAC combined with LED lighting for fully enclosed vertical farming and applications like 4-8K resolution virtual windows are already making below ground dwellings more habitable. All of these products have their origins in space technology. And when coupled with ongoing reforestry projects aided by efforts like the Trillion Tree Project, we may have decreased the rate of biodiversity loss, helped rebalance the nitrogen and phosphorus cycle through sensible farming, and the future looks very bright for Future City Evolution and the sustainability of our Earth's biosphere, as we enter the Anthropene Era from the Holocene, and a new awareness in our species reminds us we are the sole stewards of Spaceship Earth.

Acknowledgements

The Arch 599 Space and the City seminar was a 3 unit graduate elective offered in the School of Architecture in the Spring of 2020. The aim of the course was to appreciate the role of space technologies and investigate future possibilities in the design and evolution of daily operations of modern "smart" cities. We would like to thank all the faculty and visiting lecturers who contributed and the Dean of USC Architecture School Milton Curry and Dean of USC Viterbi School of Engineering Yannis Yortsos for bringing the disciplines together to imagine and create synergetic products for our collective future. Thanks to Wes Jones, Director of the Graduate Program in Architecture, who is instrumental in promoting and supporting new insights in architecture education, and to Doug Noble, Marc Schiler, Goetz Schierle and Karen Kensek for their support. Special thanks to Jane Ilger and administrative staff. Last of all, thanks to an enthusiastic & diverse group of graduate students from all over the globe, who exemplify & reflect the true diversity and strength of USC.

- E Pluribus Unum

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Afterword

The COVID-19 pandemic hit during the course of this Spring 2020 seminar. In March, just after Spring break and before midterms, the whole school curriculum was switched to an entirely online mode of instruction. Students, faculty and school administration, all had to adjust to new ways of conduct imposed by stringent public health measures to contain the rapid spread of the pandemic. Midterms and finals were conducted entirely online, with guests dialing in from around the world, and reviewers from the UK, Italy, Australia and India to watch and critique student presentations, synopses of which appear in this paper.. Cities were already seeing reverse migration during this short March-May 2020 period, as folks seeking economic benefit and improved quality of life in large cities, especially in developing nations, were heading back to their suburban and rural homelands. This trend has reversed again since, and though some irreversible changes have occurred in the way the urban hubs of economic activity operate, it appears the City paradigm still holds the magnetic charm of economic promise and freedom for those who are attracted to it.

Now there is one outstandingly important fact regarding Spaceship Earth, and that is that no instruction book came with it.
– R.Buckminster Fuller, Operating Manual for Spaceship Earth(1969), p.16