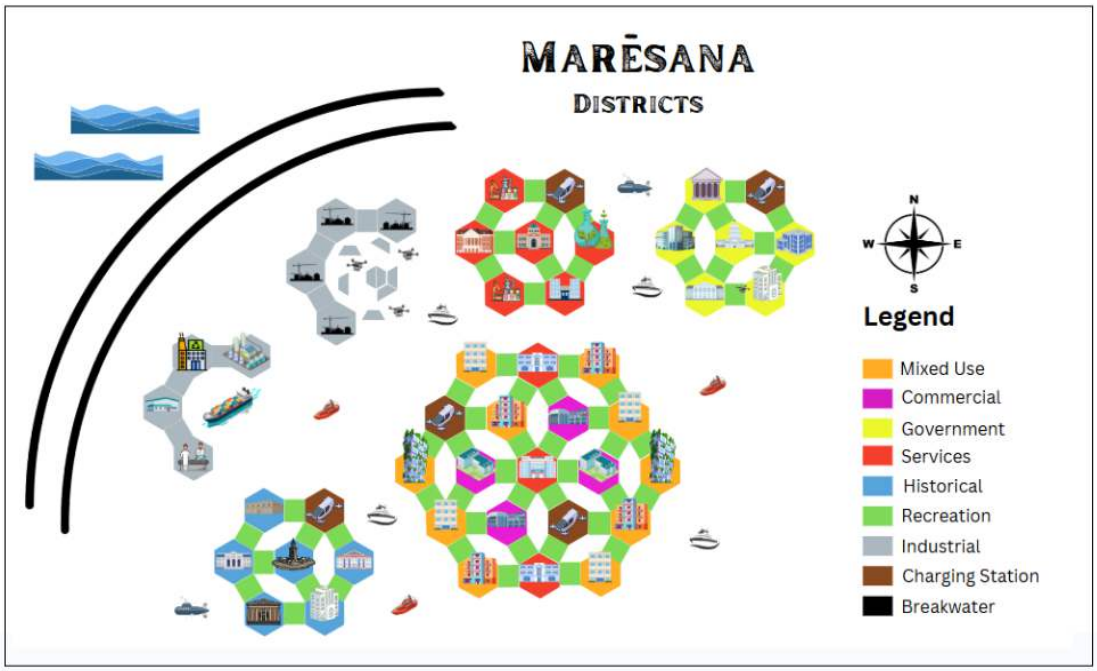
Future City

18 December 2024

Marēsana City Essay

Welcome to 2125 on the fully-floating, dazzling city-state of Marēsana! Located in a tranquil man-made lagoon protected by dual-system wave attenuators twelve kilometers off the coast of Alexandria, Egypt (31°27'06.2"N, 30°05'49.4"E), steady breezes cool the coastal climate. Marēsana, Latin for “healthy ocean,” started as floating research pods in 2025 and grew into a city of 200,000. Internationally funded, Anthropogenic Restoration of Coral Habitats (ARCH—honoring Archimedes) Initiative conducted Nile Delta research, establishing a self-sustaining community.



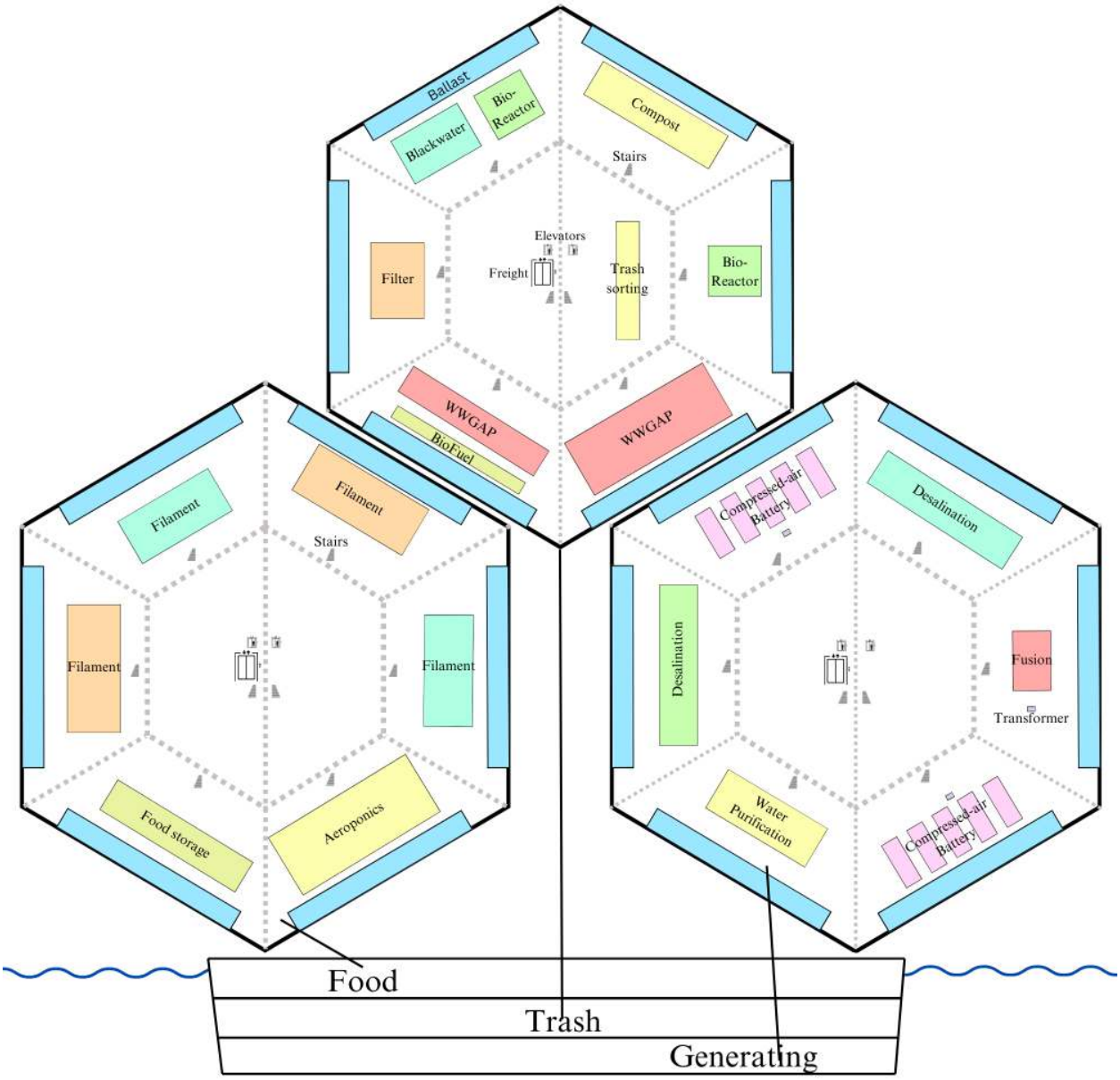
Marēsanans experience a water-based metropolitan life where air-taxis fly overhead, and hydrofoil boats navigate interconnected, circular districts. Alexandrians, aspiring students, and sea level rise refugees generate a diverse community. With seasteading and historical curiosities like the recreated Alexandria Lighthouse drawing various ages, ethnicities, and religions,

Marēsana represents a beacon of hope. Residents choose to attend mosques or churches of their choosing.

Personal Oxygen Gills allow people to explore underwater ruins. Sea life sanctuaries, outdoor water sports, and augmented reality provide fun and relaxation. Festivals like the annual King Khufu Boat Parade commemorate new beginnings and the 2053 Tsunami of Alexandria.

Marēsana's main workforce industries characterize floating life: oceanic research, tourism, fish farming, and construction. Critical activities, including the generation of food, electricity, water, and pod construction, drive Marēsana's economy; floating pod structural dynamics limit heavy industries.

Residents live on pods self-sufficient in water, electricity, and waste management. Embedded utilities allow independent functionality, while distributed systems among three pod layers create redundancy. Layer subsystems reserve area for equipment access.



The bottom and heaviest layer generates water and power. With automated monitoring and cleaning, active desalination upgraded renewable seaweed filters. Passive desalination cools fusion reactors, evaporating and recondensing water in underwater pipes. Carbon nanofiltration provides final purification. Exported residual brine supplies mainland sodium-ion battery production. Fusion micro-reactors generate reliable power while compressed-air batteries balance microgrid loads.

Closed-loop waste management in the middle layer supports a reduced environmental footprint. Waste Water Growing Algae Plant (WWGAP) produces biofuel to power hydrofoil boats. Blackwater electrocoagulation clumps sludge for processing in the bioreactor, sending filtered water to WWGAP.

The top layer contains advanced food production. Aeroponic greenhouses generate fresh produce while 3D printers produce culinary creations.

Outside the pods, distributed transportation networks maximize flexibility. Flying taxis, powered by sodium-ion batteries, travel between pods and to the mainland. Autonomous bikes provide short-distance transportation, and reduced-wake hydrofoil boats transport large groups and bulky items. Public vouchers subsidize transportation costs.

City services such as emergency response and healthcare are enhanced with AI-managed HELPbots and LifeDots. First, HELPbots (Human Emergencies and Life Problems) provide services ranging from domestic assistants to first responders. HELPbots support in-home healthcare while local clinics and two major hospitals provide human assistance. Specialized SeaForce HELPbots also protect the city's perimeter. Next, wearable LifeDots provide personal communications and criminal deterrence through surveillance and emergency support. Moreover, customized LifeDots administer medications, reducing incorrect use. LifeDots also function as inflatable life vests.

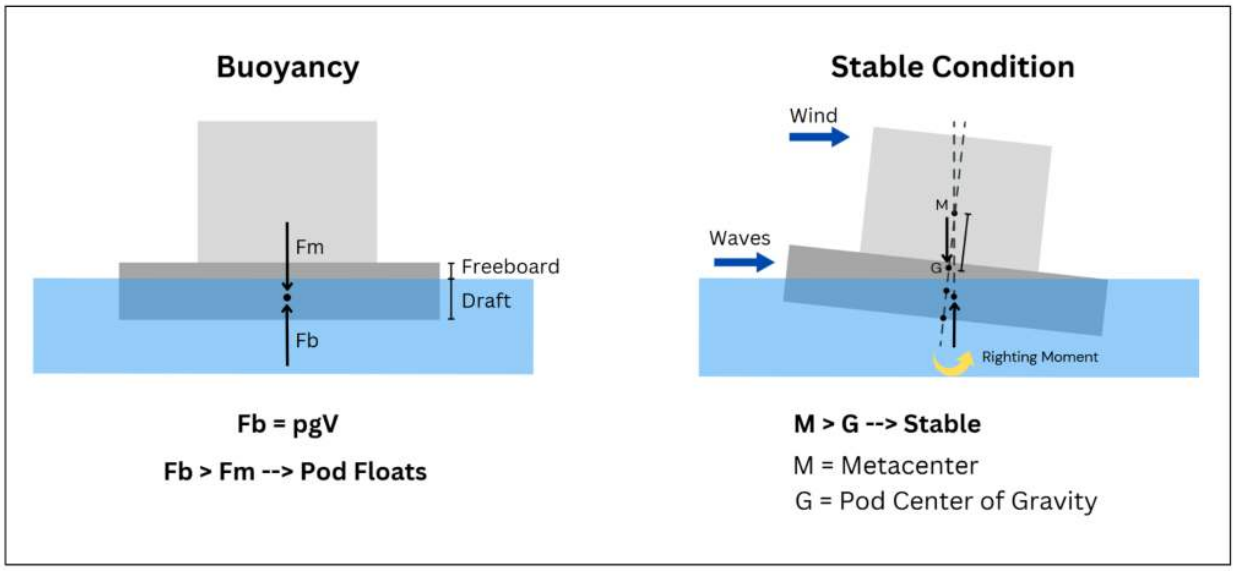
Home-based knowledge osmosis pillows, ability-based classrooms, and mentors educate residents of all ages. Archimedes Academy of Naval Engineering and Marēsana Oceanic Research and Engineering University attract students worldwide.

Marēsana prioritizes resident safety through building designs integrating fire-resistant materials, evacuation plans, first responder training, and fire stations on special marinas.

Clustered hexagonal and square pods form districts. Eight sixty-meter trapezoidal segments connect to form a hexagon with square connection pods providing greenspaces. Density ranges from one to six buildings per pod with a 60-meter maximum height.

Two systems provide position control. Magneto Hydro-Dynamic Drives (MHDD) attach to each pod, counteracting horizontal forces. Synthetic fiber ropes interwoven with carbon-nanotubes attach to seafloor datacenters, and active mooring dampeners manage storm-surges. Combined with wave attenuators, minimal movement occurs on the pod regardless of the weather intensity.

Marēsana combines static and dynamic innovations maintaining a comfortable floating life. Breakwaters, perimeter industrial pods, and MHDDs prevent drifting and bobbing. Embedded carbon-nanotubes in the hull double as strain gauges, detecting minuscule cracks underneath the self-healing Fraggle Rock exterior. This Structural Integrity Monitoring System detects issues within the hull, allowing Repair Operations bots to perform underwater repairs instead of drydocking like traditional naval vessels. Using refined buoyancy concepts derived from ancient Alexandrian Archimedes, high pod metacenters ensure stability. Inertia and seawater ballast compensate for dynamic loads, preventing capsizing. Pod decks direct excess rainwater into the ocean while capture systems supply freshwater.



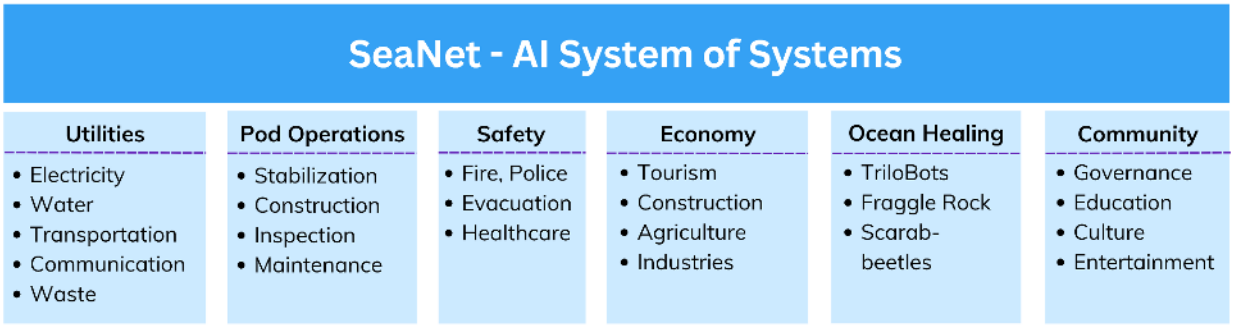
With climate change, the Mediterranean Sea gradually encroached on Alexandria, causing city planners to build coral sea walls, regenerating marine life. In 2053 a tsunami devastated Alexandria and destroyed the barriers. Refugees fled inland and to Marēsana, invigorating the economy through innovative construction.

Marēsana heals the ocean and Nile Delta, combining technology with natural solutions. Large submersible machines, “TriloBots”, filter Delta silt using electrocoagulation as scarab-beetles filter the contaminated Nile. Phytoplankton seeding with iron balances pH and oxygen levels while bio-engineered ReneeLia coral, clams, and oysters cleanse the ocean. Along with developing renewable materials, engineers mitigate environmental concerns. Exporting these techniques worldwide enhances global ecology while improving Marēsana’s economy.

Concern	Benefit	Mitigation
Datacenter disturbs silt, generates heat	Reduced footprint	TriloBots clean silt
Pod shadow effects	Localized cooling	Seagrass grows on pod sides, bio-engineered low-light coral
Wave attenuators reduce circulation	Larger, more stable pods	MHDDs circulate, aquaculture replenishes nutrients

Innovation #1

Over the years, Marēsana's engineers added numerous innovations and subsystem capabilities, requiring a master control system. SeaNet, the overarching AI model "living" in underwater datacenters, provides interdisciplinary management of six main systems. Multiple levels of redundancy and de-rated machines add safety and efficiency. Control engineers monitor and innovate the SeaNet system of systems to ensure a connected and efficient network.



As the largest system, five critical subsystems comprise Utilities. Kemet controls all electricity generation and distribution, including fusion micro-reactors and solar panels. HydroNet Intelligence Water Infrastructure connects and controls water flow. Similar systems manage LifeDot, transportation, and waste treatment.

While Utility subsystems manage critical city functions, Pod Operations and Safety Systems focus on survivability. From construction to inspection, multiple subsystems extend pod lifespan and ensure stability. Evacuation, fire protection, LifeDots, and HELPbots contribute to safety resilience.

AI is critical in the Economy subsystems, providing mixed reality workspaces, controlling construction drones and iterating research solutions. Community subsystems benefit

from AI language translation, holographic learning, augmented reality medical training and virtual reality entertainment.

Ocean subsystems showcase Marēsana's future legacy. TriloBots, Scarab beetles, and bio-engineered coral process pollutants from the Delta region such as heavy metals, toxins, untreated sewage, and invasive species. Innovations such as Fraggle Rock (a type of Biorock) assist by passively trapping microplastics.

Innovation #2

Increasing complexity and interconnectivity facilitates faster, less expensive pod construction to accommodate the growing population. GAIA (Genesis Artificial Intelligence Assembly) enables distributed manufacturing of trapezoidal segments assembled into pods. Drones extrude materials directly on the water in floating docks. Fully integrated subsystems are installed when the segments cure.

GAIA utilizes hydrophobic and buoyant materials, sandwiching Syncrete (syntactic foam and green concrete) between Exofiber (seagrass resin reinforced with carbon-nanotubes) for the ideal combination of compression and tension strength. Recovering aggregate from deconstructed buildings in flooded Alexandria and cultivating seagrass for Exofiber reduces Marēsana's carbon footprint.

Marēsana's planners contended with numerous risks, tradeoffs, and compromises including floating innovations, location, pod size, and refugee resettlement.

Considerations	Benefits	Risk/Tradeoff/Compromises
Floating	Adjustable district configuration, unlimited growth	Requires high-capability workforce, expensive
Location	Closer to coast = access, delta cleaning, coral	Depth needed for draft plus clearance
Size	Bigger pod = structurally stable/increased building area	Modularity improves constructability
Refugee Resettlement	Accommodates people displaced by flooding	Higher-density dwellings required, fewer jobs than land city

Scientists, engineers, and leaders collaboratively advance Marēsana’s future across many disciplines:

Discipline	Highlighted Job Description
Maritime	Design, build, and inspect structure and anchoring
Civil / Structural	Develop and manage GAIA
Electrical	Invent and operate small modular fusion reactors
Material	Pioneer GAIA materials and process
Biomedical	Innovate LifeDot pharmacology
System / Software	Develop and monitor SeaNet systems

Marēsanans embrace their mission to regenerate the ocean's ecosystem. Refugees enjoy protection from tsunamis and sea level rise with calming wave breaks and futuristic infrastructure. Residents thrive with proximity to cultural diversities and technological advancements. Marēsana's advanced and safe community provides the foundation for future generations of creative thinkers who innovate the world!

Word Count: 1,467

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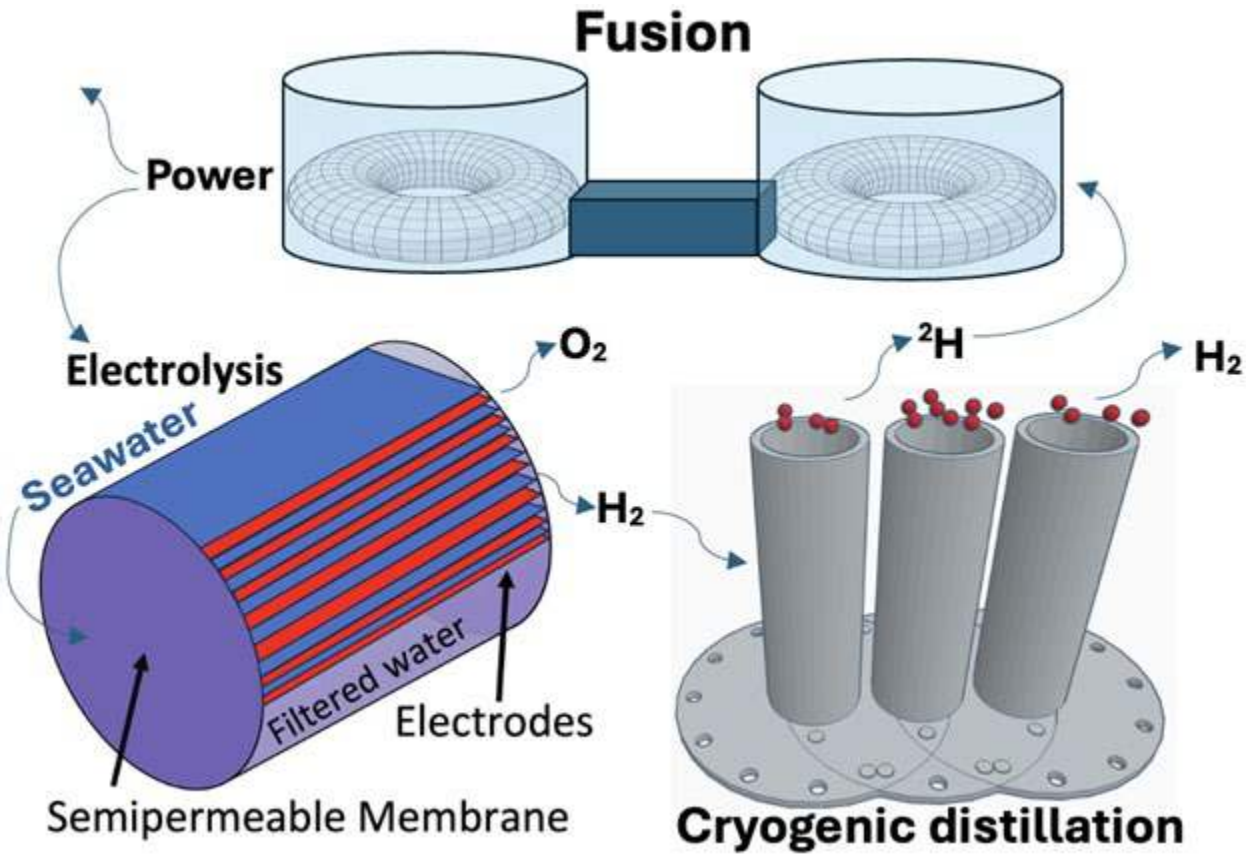
Faraeinat Albahr

Faraeinat Albahr, meaning Pharaohs of the Sea, is a floating paradise off the coast of Alexandria, Egypt. Sea-level rise destroyed farmland, contaminated freshwater sources, and created 1.1 million climate refugees that found a home in Faraeinat Albahr. In 2125, the city has maintained Alexandria's rich culture and bustling economy fueled by the Mediterranean's largest port. Citizens prosper in the beauty of the Mediterranean, enjoying lush sea life, lively urban areas, and abundant traditions as they live on the floating platforms of Faraeinat Albahr.

Residents and tourists are drawn to Faraeinat Albahr by traditional Egyptian influences, the Mediterranean climate, technological advancements, employment opportunities, and varied entertainment options. Adults easily find employment in food production, tourism, commerce, education, public service, engineering, computer science, health care, and scientific research. Underwater seascapes beneath Faraeinat Albahr delight visitors as they explore attractions like Heracleion, an ancient sunken city. Citizens savor popular dishes like Gambari Mashway and Samak Mashway while strolling by attractions like pristine hydroponic parks and the new Library of Alexandria.

The Ancient Library of Alexandria was the pinnacle of humanity's knowledge. It is now a vast data center, with 7G technology, digital DNA storage, high-end encryption, and AI systems running on servers powered by 3D chips, creating a digital utopia. Another example of the library's impact is an AI that knows patients' medical histories, tailors treatments to their genetic profiles, and delivers care through advanced robotics. A recommended chip under the skin monitors nutrient levels and detects abnormalities that alert users, high-speed medical boats, and hospitals.

Because Faraeinat Albahr is floating off the coast, nuclear engineers developed a self-sustaining fusion system, powered by the sea, that doesn't rely on the mainland and ensures citizens never run out of electricity. Tokamaks, hollow toruses, generate electromagnetic fields to confine and fuse two hundred-million-degree deuterium plasma. This reaction releases He-3, H-3, and He-4 while averaging 9.39 MeV per reaction. Next, H-3 is fused with another H-2 atom, resulting in a net gain of 17.6 MeV per reaction. This process produces 67.9 billion volts per cubic meter of seawater. Fusion reactors were costly, but this tradeoff was worthwhile as it guaranteed vast amounts of consistent inexpensive energy that doesn't disrupt the environment. Some energy is used to electrolyze water in submerged containers with semipermeable membranes that filter seawater before it travels between electrified plates. This causes the seawater to divide into oxygen and hydrogen, which is stored to power vehicles. Some of the hydrogen is deuterium that is separated through cryogenic distillation and cycles back into the tokamak.



Hydrogen fuel-cell-powered underwater transportation pods and cargo ships use Magnetohydrodynamic thrusters to electrolyze water, creating a magnetic field repelled by electromagnets. This system pushes water, propelling the pods throughout the city and also allowing cargo ships to traverse the Mediterranean. Citizens also use a submerged circular MagLev loop with independent vessels to travel longer distances throughout Faraeinat Albahr and to the mainland. Each vessel levitates on electromagnets, increasing speeds while reducing friction. They divert from the main loop into stations throughout the city without breaking the loop's flow. Citizens can travel on electric walkways between adjacent platforms, while elderly and disabled individuals drive small, motorized scooters.

Floating on the Mediterranean limits options for waste disposal, so Faraeinat Albahr composts biological waste and developed seaweed-plastic substitutes to reduce waste by extracting and mixing polysaccharides. For the little waste that is not biodegradable, plasma gasifiers heat waste at high temperatures without combustion to produce glass-like slag and synthesis gas, which powers the gasifier. The excess CO_2 from this process is used in the vertical farms.

Before Faraeinat Albahr was constructed, Alexandria was trapped between the Sahara Desert and rising seas. The Mediterranean Sea rose approximately 120 centimeters since 2024, submerging one-third of Alexandria and displacing 74% of its citizens. High soil salinity damaged crops, erosion weakened foundations, and rising sea levels submerged underground transportation systems and jeopardized rich Egyptian culture by engulfing famous landmarks.

Geochemical and structural engineers combatted these catastrophes with readily available cost-effective materials to slowly grow Faraeinat Albahr. Each platform is a hexagon that has side lengths of seventy-five meters, is five meters thick with partitioned chambers, and can support 170 million pounds. Platforms are made of biorock, a self-healing concrete grown through Mineral Accretion Technology around an electrically charged marine-grade aluminum base containing magnesium and silicon alloys to prevent corrosion. An anode oxidizes seawater and causes surrounding minerals like calcium carbonate to gather, creating a self-healing material stronger than traditional concrete. Additionally, biorock absorbs chemical pollutants, helps to grow coral, restores marine ecosystems, and enables sustainable construction. While platforms take 2.5 years to grow on water-tight aluminum hexagonal prisms, their cost-effectiveness and environmental impacts make

growing the platforms a worthwhile tradeoff.

Platforms are organized in groups of nineteen, forming a community. Seven communities form a district, and seven districts form the city, allowing for methodical expansion. Each community is named after an Egyptian pharaoh such as Akhenaten, Tutankhamun, and Hatshepsut to honor culture and promote tourism. Buildings are generally five stories, spread evenly to ensure proper weight distribution, and made from concrete. Since sand traditionally used in concrete became scarce and expensive, chemical and structural engineers discovered how to use sand from the Sahara, previously unusable due to its round grains, by combining it with remains of old buildings to form concrete from readily available and recycled materials.

Our position in the Mediterranean protects us from hurricanes and tsunamis. A curved floating breakwater made of biorock absorbs energy from incident waves and creates a weak

transmitted ripple. Nano-fiber polymers tether the breakwater and platforms to the sea floor, holding them in place while allowing them to fluctuate with tides and adapt to additional sea level rise.

Ecologists were concerned that platforms supporting our city could restrict underwater light access, potentially killing phototropic organisms and destroying ecosystems. To prevent this, full-spectrum lights on the bottom of our platforms illuminate the sea and support photosynthesis. The environment also benefits from the removal of distressed structures and restoration of natural shorelines, where halophytes and genetically modified vegetables grow in saltwater marshes. This protects the coast from further erosion, creates habitats, and stores carbon to combat climate change.

Due to lack of soil, Faraeinat Albahr has pyramids dedicated to hydroponic vertical farming, spirulina, and aquaculture. Biochemical engineers genetically modified plants to grow in saltwater vertical farms. Because Dunaliella Salina grow optimally at a salinity 3-6 times that of average seawater, engineers copied their genes and inserted them into fruits and vegetables using CRISPR-Cas9. Guide RNA directs the enzyme where to cut the DNA and RNA scaffolding helps Cas9 nuclease bind with DNA. Fish farms surround the vertical farms, creating nutrient-rich water, which circulates throughout saltwater aquaponic vertical farm systems. Just inside the fish farms, Spirulina, a superfood algae rich in protein and nutrients, grow in massive clear tubes. Kelp and other edible sea plants grow underneath platforms and floating barriers.

Faraeinat Albahr produces lab-grown meat by extracting animal stem cells and placing them with amino acids, carbohydrates, and other nutrients, allowing the cells to multiply and develop into muscle tissue. The facility uses 99% less land, 96% less water, and 96% less

greenhouse gas emissions than traditional animal farming methods. We also grow proteins such as clams, mussels, and scallops within cages in the sea.

Hydrological engineers approach the common struggle among floating cities of collecting fresh water with a 10-stage evaporator and condenser system. At the top of the system, a solar absorber heats seawater that cycles through a pipe at the bottom. Each stage uses a thin horizontally divided chamber at a 30° tilt, enabling the varying densities generated by temperature and salinity gradients to create thermohaline convection currents. These currents prevent the build-up of salty brine that plagues most distillation systems, as the saltier, denser water sinks out and fresher water cycles in. A hydrophobic membrane at the bottom allows water vapor to pass through an air gap into a lower chamber where it condenses, and travels to freshwater storage. The condensation releases heat energy equivalent to eighty percent of the energy from the solar absorber, powering evaporation in lower levels. This system produces up to twelve liters of water per hour, per square meter.

Faraeinat Albahr also preserves water and decreases pollution by treating wastewater with Electrocoagulation, where electrodes release ions that attract dust and waste particles, combining them into larger particles caught by filters. Water is then disinfected by UV lights and recycled for citizens' use.

When rising sea levels and climate change threatened Alexandria and its people, Faraeinat Albahr grew into a home that provides an abundance of food, water, and shelter for climate refugees. The city maintains its vibrant history and traditions while being a pioneer in advanced technologies with innovative solutions to environmental concerns, enabling Alexandria to float above the ravages of climate change and become our

floating haven - Faraeinat Albahr.

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Lilium

Welcome to Lilium, a future territory of the US. Our city name reflects the configuration of eleven separate pods similar to lily pads. It is located 30 miles off the coast of Cape Canaveral, Florida. Construction began in 2050 as a solution to rising seawater. A goal was to establish a replacement for the Kennedy Space Center. The population of Lilium as of 2250 is 30,000. Our city's landscape contains green spaces, grassy terrain, swimming pools, sports venues, and scenic oceanic activities.

Citizens benefit from an amazing space program, resilient infrastructure, severe weather safeguards, longevity, diversity, and gorgeous landscapes. Some inconveniences include shared spaces, limited personal transportation, tourists, hurricanes, and isolation.

Our diverse population ranges in race, age, and religion. The primary industry in Lilium is the space program. Other jobs available include healthcare, maintenance, agriculture, social work, finance, and education. Daily life includes work or school, recreational activities, neighborhood gatherings, and family time. For entertainment, citizens and tourists enjoy Astroland located on Prospect Pod with an interactive roller coaster and AI-based holographic activities. Cruises, space camp, sports, fishing, boating and multi-dimensional movies are also available.

An aspect of our city which some may find undesirable is the density of Lilium’s population; however, citizens enjoy living near loved ones and neighbors in one of three residential pods which include a K-8 school, stores, and parks. Everyone lives in condominiums or apartments. Most daily activities are within walking distance. Public trams, hoverboards, and bikes are available for greater distances.

Each pod has power grids, water systems, healthcare, stores, and emergency services. The

Central Armstrong Pod, CAP, supports larger facilities including the Religious Campus, Lilium Hospital, Galaxy Mall, Grissom Space Academy, Ride High School and University, and Emergency Services. Computer engineers created a hack-proof system to eliminate threats. The Glenn networking system monitors, detects, and repairs issues in real-time. This system blocks risk areas from affecting city services.

Lilium uses wind, sun, and water turbines to produce electricity. Our citizens produce food by using hydroponics and aquaponics on the Agricultural pod. Hydroponic plant roots get water sprayed from intermittent sources. Aquaponics is a food production system where fish are raised with plants. All of the fish waste fertilizes the plants and keeps the water clean in return. These agricultural processes increase yields 30% in a shorter growing season.

Our bioengineers developed lab-grown meat made from animal stem cells. These engineers add natural amino acids, carbohydrates, nutrients and calories to promote growth. 3D printed food transforms these foods into a variety of products.

As a replacement for the flooded Kennedy Space Center, Lilium provides space services to private companies that have joint ventures with the American government. Pods for launches move away from the main pod during launch to reduce risks.

Each residential pod has a health clinic to monitor and address non-life threatening issues. Emergency vehicles run under the city for quick access to the central hospital. Lilium

utilizes drones and AI-enhanced robots to monitor fire and other emergency situations.

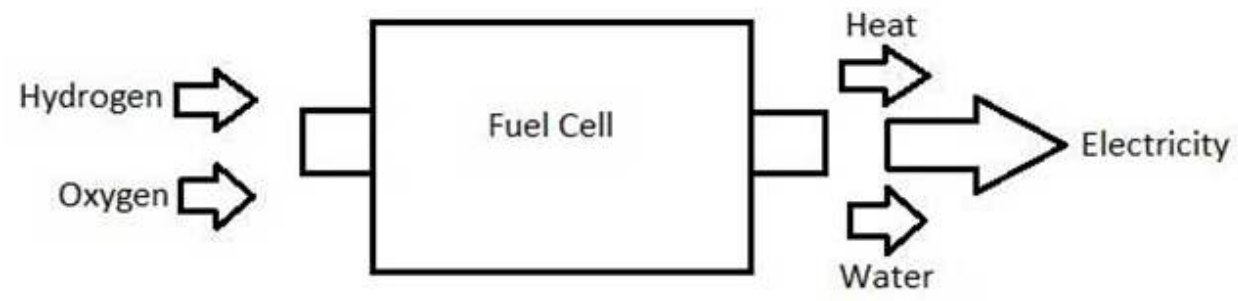
Transportation systems use hydrogen power. One kilogram of hydrogen operates a personal device for 100 kilometers. The Hydrowave, Hydro-Nova, Hy-Flyer, hydrogen powered boats and hover-planes, provide citizens an innovative form of public transportation.

Students attend school during K-8 on their residential pod. Interactive desks, holographic educators, VR experiences engage students through these earlier years. Entering grade nine, they attend school on the CAP at Ride High School and Space Academy. All seniors spend four weeks on the International Space Station to develop intergalactic skills.

Many of Lilium's futuristic elements involve the infrastructure described above including a resilient energy, water grid, 3D printed lab created food, and robotic emergency workers.

Additionally, our advanced electrical grid uses three sources. Underwater turbines capture the Atlantic Gulf Stream to generate 45% of our electricity. Hydraulic engineers designed a funnel entrance to multiply the speed when water passes through a constriction, causing the water to move faster, driving water turbines.

Transparent solar cells in every city window convert energy from the sun. Aerospace engineers designed small vertical wind turbine generators which improve efficiency over legacy rotor turbines by 67%.The electric grid is resilient with redundant power lines distributing the power throughout the city.



Production of hydrogen from our electrical system provides for power storage. Chemical engineers designed fuel cells to regenerate electricity by combining the hydrogen with oxygen from the air through an electro-chemical process. The hydrogen provides power everywhere portable energy is required while eliminating the use of fossil fuels and batteries.

 In 2025, citizens ignored warnings to use clean energy, restrict water usage and recycle whenever possible. Warmer temperatures caused the ocean water to rise when the glaciers melted. Officials met to discuss the impact of rising ocean water which would flood the launch site at Cape Canaveral, Florida by 2075. Specialists and engineers developed a plan to create Lilium. As the US recognized the Cape Kennedy Space Center as a national resource, we received significant governmental support for the development of Lilium.

Lilium's eleven pods consist of residential, industrial, space, and agricultural spaces. Civil engineers placed ten pods around the central pod. The central pod is 1.5 kilometers in diameter while the smaller pods are 0.33 kilometers.

Structural engineers developed the pods from graphene, self-healing concrete, and recycled steel. Graphene is very light, stronger than steel, and resists ocean corrosion. Lilium floats on redundant hollow tanks, which include computerized heavy weights to stabilize the city during rough seas. Civil engineers located key infrastructure elements, including electrical, water, and computer systems, within the tanks. The electrical turbines beneath the tanks can be powered to provide propulsion to move our pods to safer areas during severe weather. Anchors secure the city to the ocean floor and are detachable.

Our city design minimizes the negative impact of interfering with water flow, changing migration patterns, and altering sedimentation. Marine biologists helped to design anchors made with concrete containing holes to create a new habitat for sea creatures. The ocean stabilizes Lilium's temperature creating a moderate climate year round. The city's power, public transportation, and launch vehicles run on hydrogen which eliminates carbon dioxide emissions. To ensure good water quality, civil engineers developed innovative systems to manage waste and purify water.

Since waste was a major concern for our city, Lilium has a large-scale recycling program to eliminate wastes. Environmental engineers developed plastic-eating fungi found in the ocean which break down plastic into organic matter used in our gardens. Lilium requires industries to use mycelium, a manufactured biodegradable, compostable fungus from agricultural waste. Mycelium serves as an alternative to styrofoam, plastic, and wood composites.

One of Lilium's innovative and futuristic concepts is our production and use of hydrogen, which eliminates carbon emissions. Engineers created hydrogen fuel cells to produce energy that powers our city and move our public transportation. Using water from the ocean, electrical engineers designed a system to generate electricity. Electrolysis separates water into hydrogen and oxygen. Vehicles contain compressed hydrogen gas stored in tanks that is fed into the fuel cell where it reacts with oxygen to produce electricity to power the vehicle.

Another innovative system is the integrated water system, which relies on rainwater, ocean desalination, waste water recycling, and water exhaust from fuel cells. Each source has a unique prefilter that feeds a final system to eliminate chemical and biological hazards. Our Hydro-Bubble stores clean water and distributes it by gravity to areas when needed.

The Rain Drain collects rainwater from every building that flows into our water filtration system. Lilium’s precipitation has an average of 135 centimeters a year. Desalination uses a special membrane that allows only water to pass through, blocking the salt. To push the salt water through this membrane, strong pumps apply pressure, ensuring that only pure water comes out on the other side. Recycling filters all wastewater for reuse, eliminating any discharge into the ocean. Water resulting from the use of hydrogen fuel cells requires

no filtering before the final system processing.

Lilium's many benefits include some compromises. While residents enjoy the mild climate and sense of community, some people feel cramped. Space is limited, so apartments are smaller. Citizens may also feel isolated due to Lilium's location. Our 80% average humidity can damage buildings, so Lilium's graphene structures offset this with their ability to repel water and fight against mold and rust.

Engineers are everywhere on Lilium. Aerospace engineers develop spacecraft in the aerospace industry. They are responsible for the development of the orbital program for travel to and from space stations and planets. Computer engineers help to create, monitor, and repair our vast computer systems that run our electrical, environmental, and water technology. Civil engineers plan and develop our city infrastructure. Other engineers involved with our city are mechanical, chemical, environmental, fuel cell, and agricultural experts. Lilium needs engineers for technology, space, software, and more. The use of masterful engineering makes Lilium a true city of the future.

Word count: 1493

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Elysium

13 December 2024

Introduction:

Throughout China's history, flooding and overpopulation have caused land subsidence, and following the destruction of typhoon Bebinca in 2024, thousands of citizens were displaced. In the desperate search for safety, Elysium was designed to provide homes to an ever-expanding population. Now, floating amidst the Okinawa Trough along the Ryukyu Island chain in the East China Sea, Elysium's 210,000 residents ride the currents of possibility in 2124. Although Elysium's location makes obtaining freshwater and energy challenging, utilizing innovative technologies allows it to remain committed to safeguarding its citizens.

Elysium consists of 21 self-sufficient Resilient Environmentally Efficient Foundations, (REEFs), each holding 10,000 residents. Every REEF incorporates structures above and below the waterline. Underwater residential zones shelter most of Elysium's population in water-tight, oxygen-rich modular units intermixed with commercial zones, green spaces, and emergency services. Each unit is prefabricated with lightweight materials, ensuring quick construction and expansion. Elysium's industrial zone oversees eco-friendly energy and goods production.

Elysium's agricultural zones provide citizens with year-round food through aquaponic systems. Crops grow in a recirculating system that uses fertilizer from fish as nutrients while plants clean and cycle the water to the fish. At the bottom of REEFs, microbial labs study organisms to ensure the food's quality and produce natural sugars that can generate nutrients found in meats. Each technique conserves space and reduces carbon emissions.

Elysians of all ages and nationalities possess distinct skills to thrive in a productive society and create a sustainable future. Residents work in careers from civil engineers to marine biologists. Outside of work, Elysians participate in aquatic activities, shop at outdoor markets, and relax in open green spaces in the city's recreational zones. As a benefit of citizens' active lifestyles, Elysium collects energy through friction of piezoelectric tiles throughout pedestrian paths.

Along with piezoelectricity, Elysium is powered by Seawater Arranged Purification (SWAP). SWAP creates energy as waves enter through a semipermeable membrane that encircles the base of each REEF. Its microscopic pores

slow incoming waves while preventing marine life from entering. After passing through the membrane, turbines spin to convert wave motion into mechanical, and then electrical energy.

The waste management system funnels grey water through graphene filters to remove harmful substances making them safe to recycle into usable water. Solid waste is collected separately and processed into paper and fertilizer. Green roofs above the waterline harvest and store rainwater to reduce stormwater runoff.

Jiā(s), meaning home in Chinese, are mixed-zone community centers located on the upper level of each REEF. They offer emergency healthcare, public transport, and educational

facilities. Healthcare provides each citizen with customizable SmartBands that continuously monitor vitals. During a crisis, medical drones are deployed, providing critical information to trained specialists. The real-time data enhances the efficiency of Elysium's disaster-response system.

Sustainable Innovative Transit System (SITS) stations in Jiās provide citizens with their choice of public transportation. Public Air Vehicles (PAVs) utilize vertical take-off/landing technologies to permit airborne transport throughout REEFs and travel to the mainland. Hydro-Pods travel above and below the ocean to navigate between REEFS. For vertical transit inside the REEFs, citizens ride MagLevators powered by magnetic propulsion.

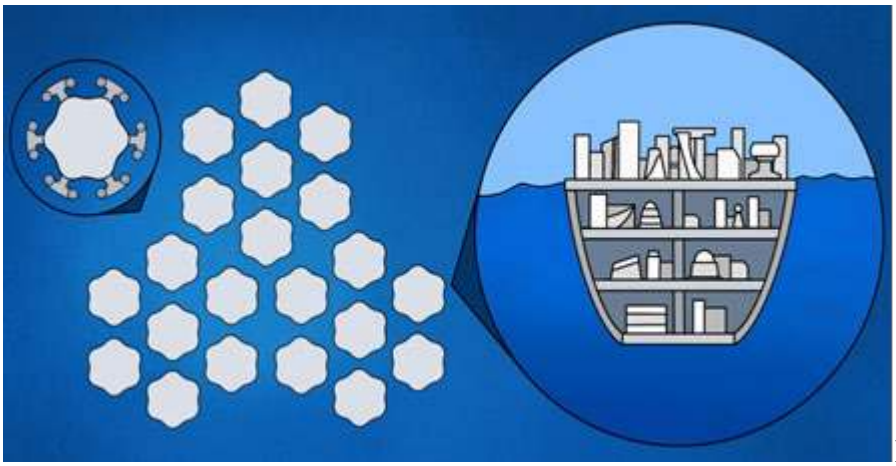
Using SITS to commute students, educational facilities are designed to teach children about their specific career paths. The Future Response-to-Intervention (FRTI) curriculum nurtures students' problem-solving skills. Students are taught the wonders of science, mathematics, technology, and literature using immersive simulations that provide a comprehensive and integrated approach to learning.

Impact:

Before Elysium was founded by the Climate Change Impact Engineers (CCIE), an organization dedicated to combating rising sea levels worldwide, the ocean destroyed cities such as Beijing, Shanghai, and Ningbo. Land and structures were sinking at an alarming rate of 12 millimeters annually, due to excess groundwater extraction, leaving large portions of the East China Sea coastline entirely submerged. By 2024, billions of dollars of damage had amounted, and thousands of citizens lost their lives or had nowhere to call home. The CCIE was inspired to create a sustainable utopia, protecting the citizens and future

generations.

Function:

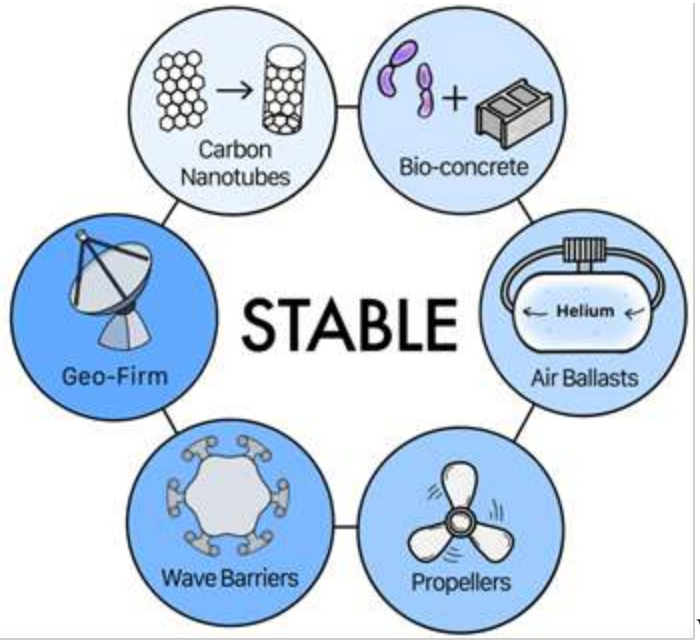


Each REEF has an inverted pyramid design meant to mimic an iceberg, with 30% floating above the water and 70% below. The 30/70 design creates a low center of balance since most of the weight is underwater. Hexagonal-shaped levels of the REEFs decrease in surface area as they lower into the ocean, ensuring stability in all weather conditions. With every REEF being 0.2 miles^2, Elysium has a total area of 4.2 miles^2 but can expand as the population demands. REEFs utilize halobacterium-infused bio-concrete to reduce carbon dioxide emissions, resist floods, and withstand salt water. This material heals itself through microbiologically induced calcium carbonate precipitation. Elysium's Defensive Barrier System (DBS) employs AI-integrated technologies to enhance its storm mitigation plan. Designed to predict storms before they occur, the system incorporates sensors to monitor sea-floor patterns, large waves, and atmospheric pressure changes. To address the development of air-borne disasters, DBS integrates thermal cooling platforms to lower the temperature of surrounding water and embeds electromagnetic pulse technology to disrupt tornado formation, enhancing the safety and resilience of the community.

Environmental Impacts:

Utilizing cutting-edge materials and technologies, Elysium contributes positively to the ecosystem in which it thrives. Buildings feature photocatalytic coatings that activate ultraviolet rays, break down pollutants, and generate oxidizing agents to eliminate airborne toxins. Additionally, the halobacterium inside the base of each REEF provides nutrients for marine life, acting as artificial coral. Nonetheless, a floating city could deprive aquatic life of sunlight. Bioluminescent lights use a natural chemical reaction to mitigate this negative impact and produce light without the sun. To alleviate marine debris, biodegradable, protein-based algae polymers replace plastic.

STABLE:



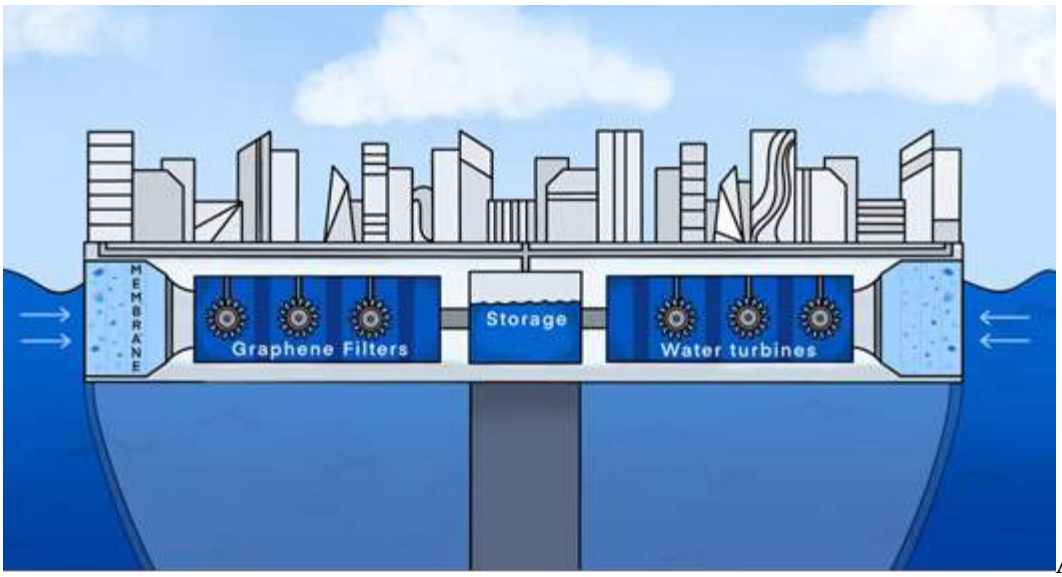
When designing the city layout, the CCIE implemented Structural Technologically Advanced Buoyant Latticework Enhancements (STABLE), the underlying structure supporting Elysium's foundation. The

halobacterium-infused bio-concrete is molded into a lattice-like carbon nanotube frame. These cylindrical tubes composed of rolled graphene sheets possess extraordinarily high tensile strength and buoyant properties, allowing them to float and withstand large amounts of deformation.

Wave barriers extend from each REEF to diffuse large waves and create a wider surface area for greater stability. The design also creates protective marinas for residents and wildlife.

Air ballast and Geo-Firm systems inside the nano-tube frame provide buoyancy and stability under every REEF. Air ballasts, constructed with bilayer aerogel, are enclosed sacks of compressed helium equipped with sensors that adjust the ballast's air dynamic density to maintain ideal buoyancy. Utilizing an AI-embedded algorithm, Geo-Firm maintains Elysium's geographic location. Each REEF is locked into its exact geo-synced coordinates, to maintain its position. Geo-Firm analyzes wave strength, height, and wind speeds to determine how fast to spin titanium propellers, preventing the REEFs from moving or tipping. Each propeller constantly rotates in a different direction and speed to maintain each REEF's stability.

SWAP:



A significant concern is the availability of drinking water in the ocean—a vital component of human life. Implemented inside the SWAP system, graphene filters transform waves into purified drinking water. After penetrating the outer membrane, ocean water flows through a course of turbines and graphene filters, a nanopore technology composed of graphene oxide. Highly efficient nanopore sifters remove contaminants like viruses, oil molecules, and salt ions, creating clean fresh water. The freshwater is distributed to storage containers throughout the levels of REEFs for everyday consumption.

Any salt filtered from the water is collected and used for consumption or added back to the water to be slowly reintroduced to the sea, benefiting marine life. To remove all contaminants and bacteria, the salt is exposed to Ultraviolet C rays, deactivating microorganisms. Once citizens use the water, grey water enters the graphene filters in the waste management system to be purified.

Additional Risks/Tradeoffs:

Elysium utilizes complex systems to outweigh all possible risks, keeping citizens healthy and

safe. A human body can survive without food and water for only one week, and living out in the open sea risks a lack of fresh water and food. To mitigate this, graphene filters and agricultural methods aim to supply citizens with vital necessities. Elysium presents a tradeoff between safety and seclusion, ensuring citizens secure homes that may instigate isolation, but still encourage united communities.

Engineering Disciplines:

The three main engineering disciplines, environmental, marine, and structural work towards creating systems throughout the city and maintaining their ecological sustainability. Structural engineers design, analyze, and maintain STABLE, the framework of Elysium. They strategically work alongside marine engineers, who overlook the design, operation, and maintenance of SWAP within the infrastructure. The environmental team moderates using natural resources through green techniques, ensuring the safety of citizens and wildlife.

Over the past century, Elysium has served as a haven for over 210,000 displaced residents. Enhanced by STABLE and SWAP, Elysium ensures citizens never lose their homes again. As a pledge to always stay *above the current*, Elysium strives to be the paradise of the world—a space for thousands to float on to the future.

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Isla del Mar, Water Paradise

Welcome to Isla del Mar, island of the sea! The Isla is an alluring, diverse city full of radiant, sandy beaches, clear, crisp waters and captivating city skylines. The five islands are located off the coast of Guaymas, a city in northwestern Mexico 332 miles east of Baja, California. The islands are ~1 mile from the ocean floor. Guaymas was on track to be submerged by 2100; however, the new city has been designed with maximum resiliency. The city has an abundance of traditional festivals, including La Festival de Colores. This annual festival features colorful decorations, dances, and the sweet, familiar tunes of mariachi bands. Residents benefit from the subtropical desert climate with a plethora of sunlight and vitamin D. Unfortunately, hurricane season is a drawback; however, this is combated by creating barrier islands that diminish storm impact. Isla has a population of 70,000 residents with a median age of 56.

Resident's daily lives include swimming, boating, and snorkeling in pristine waters. Isla provides stable careers for residents, including engineering, tourism and skilled jobs. With a three-day work week, people have time to walk in passive and active parks and along the beach. A popular sport is hydro-boarding, which safely utilizes magnetic levitation and ion thrusters. Swimming classes are provided by the city to ensure resident safety. The city has a representative democracy where people vote for city council and referendums.

Isla's infrastructure incorporates nanotechnology, advanced AI, and IoT. Buildings are sustainable and 3D printed. Buildings feature agricultural walls, efficient LED lighting and are coated in Solar Chroma®, a photovoltaic paint containing a flame-and-heat resistant material, Cartenium® (Carbon-Tungsten-Rhenium). IoT, nanotechnology, and

AI control smart appliances and air quality, enhancing daily life. Ocean temperatures mediate comfortable temperatures outside and inside. Generators recover heat energy from interiors to be recycled for reuse, and elemental lighting promotes a natural circadian rhythm for occupants. Packages are delivered to buildings through a delivery vacuum system, as it is more efficient and prevents packages from becoming lost or damaged. Nanotechnology purifies greywater and blackwater. Blackwater excess is incinerated using advanced technology that collects thermal energy. The residual is a supplemental building material which strengthens homes and islets. Greywater irrigation releases necessary nutrients to agricultural walls. All products are made from recyclable materials.

Advanced AI diagnoses patients and prescribes treatments. Nanobiotic injections perform open-loop bioelectric therapies, deliver treatment, and monitor bodily functions. Bioelectricity instructs cells to function in certain ways, delivers cancer therapy, cures chronic illnesses, and regrows limbs and organs. Clothing, adaptive textiles, adjusts to growth, monitors heart rate and blood pressure, and detects imbalances in body temperatures. Nanotechnology aids in water analysis and filters chemicals, salt, and other harmful materials out of drinking water. Hydrorails, a high-speed tubular transport system, utilizes biomimicry and jet propulsion on rails made from durable, self-healing concrete and marine-grade stainless steel.

Isla's education system, Student Personalized Education (SPE) is tailored to each student, helping to improve proficiency, using three-dimensional simulations in real-life scenarios.

Underwater regenerative farming harnesses ocean resources for a sustainable source of food.

Filter feeders such as shellfish improve water quality. Seaweed absorbs excess carbon and releases oxygen, creating an optimal ecosystem and purifying the ocean to restore a healthier environment.

Underwater vertical farms utilize hydroponics, aeroponics, and aquaponics to grow food sustainably. Nanodrones pollinate plants, plant and harvest crops, and monitor light, water, and nutrients. Bioelectricity produces both plant-based meat and meat artificially grown from animal cells. Plant cells are instructed to produce proteins, while animal cells are instructed to form meat.

Nanobiotics also serve as telepathic communicators. People choose when to communicate with others and their surroundings. Bots are connected to the IoT, and home settings are controlled mentally.

Prior to Isla's development, the citizens of Guaymas suffered mass displacement due to a 3.5-foot sea level rise. Economic effects were catastrophic, with a 15% GDP decrease and tourism decline. However, the new island city thrives on agriculture, tourism, and aquaculture. Guaymas' agricultural fields/valleys were flooded and ruined; however, the city now utilizes regenerative vertical farming underwater. Saltwater intrusion destroyed the environment, turning the water brackish and devastating animal habitats. Fortunately, the biorock used in the new city's foundation and barrier islands create animal habitats.

Isla is arranged in an interconnected layout. The circular outer islets are 20 mi^2, while the center island is 25 mi^2. Islets are 4 miles apart and one mile from the principal island. Islands are mixed use zones and consist of immersive museums, engineering universities, and mesmerizing restaurants. With the hydrorail system and walking paths atop the water, all residents have easy access to travel between islands and the mainland. The hydrorail and

other hardscape in our city are made with innovative self-healing concrete.

To float the city, the buoyant island bases are created with self-healing, lightweight and buoyant concrete. Islands are coated in and anchored by biorock substructures, which strengthens with age, self-healing and corrosion resistant. These biorock anchors allow the platforms to remain in place, rising and falling with water levels. To mitigate storms, barrier islands are created for islets which are ~5 miles long and ~15 ft tall. Sensors monitor/indicate barrier health and determine replenishment and reinforcement needs. Reports are relayed to the city's health and safety hub.

Unfortunately, the islets block off essential sunlight for marine life, so artificial light is utilized to simulate the natural environment. In addition, marshes on barrier islands provide animal habitats. Biorock used in island foundations creates marine and oyster reefs, with oysters being natural purifiers that clean the water. Submerged parts of the islets are susceptible to biofouling, which can transfer invasive species and harm ecosystems. As a preventative, low intensity ultraviolet lights are installed with sensors that monitor environmental conditions. The sensors adjust the ultraviolet lights accordingly to prevent harming aquatic life. Islands/islets are all carbon neutral, and landscape plants are moss which takes carbon out of the atmosphere. Moss absorbs water and are bioindicators of air quality.

The city utilizes atmospheric drinking water to provide fresh water to residents. Units are deployed in each building, and Solar Chroma® energy from battery farms powers internal water treatment systems. Units are compact and take up little space in buildings. Each Atmospheric Water Generator (AWG) unit produces up to 40 gallons of water per day. It draws air into the generator, and debris is filtered out, where a heating/cooling

process creates condensation. Water passes through filters and is stored in a reservoir where it's perpetually circulated to keep fresh. In addition, rainwater is collected, stored, and filtered.

Due to its location and sea-floor hydrothermal vents, the city utilizes hydrothermal energy. Descending seawater interacts with magma, releasing chemicals, creating temperatures up to 900°F. Hydrothermal energy is converted into electricity using thermoelectric generators (TEGs), which generate electricity based on temperature differences (Seebeck Effect). A compound metal Copper-Molybdenum-Selenium ($Cu_4Mo_6Se_8$) is used in the TEGs as it has the highest conductivity. Energy is collected and sent to battery farms. Sensors are installed on TEGs for maintenance and monitoring. Generators are made of self-healing polyurethane.

The AWG system initially costs money to manufacture and install. The unit requires dedicated space, a compromise, and needs specific temperature and humidity conditions to function. AWG saves money in the long term and gives the residents the benefit of unlimited water to use. Our second innovation, hydrothermal power can affect water quality and consumption, as the water pumped contains dangerous chemicals, posing health risks. To avoid this, a closed loop water system is used so water is pumped back into the reservoir. In a closed loop, gasses aren't exposed to the atmosphere because they are injected back into the ground after they aren't useful. Some power plants also have dangerous mercury emissions, which is mitigated using expensive mercury filter technology.

Water resource, mechanical and geotechnical engineers worked in an integrated project team to design our innovative water and energy sources. They used cost benefit analysis to

determine if projects were worth the initial investment compared to long-term savings.

Water resource engineers assessed the water needs of the city by analyzing water demand, population, and resources. They worked with mechanical engineers to design the AWG units and tested them to make sure they were functioning properly and oversaw the unit implementation and monitored progress. They developed, evaluated, and tested the AWG units to ensure ideal results. Construction engineers helped integrate the units into buildings with optimal placement. Sensors indicate predictive maintenance and evaluate water quality.

Geotechnical engineers and marine geologists survey the ocean floor to locate potential energy sources. Then they estimated the amount of energy coming out of the vents and examined the impact construction would have on marine life. They also assessed geohazards such as seabed mining and the building of pipelines. Mechanical engineers designed, optimized, and maintained the unit. They designed, developed, built, and tested sensors that monitor the health of the generators.

Thanks to innovative engineering, Isla Del Mar is a resilient, healthy, and safe island city.

1493 Words (1498 with title)

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