FLOATING NEXUS

Tung Chung 2050

Group A1
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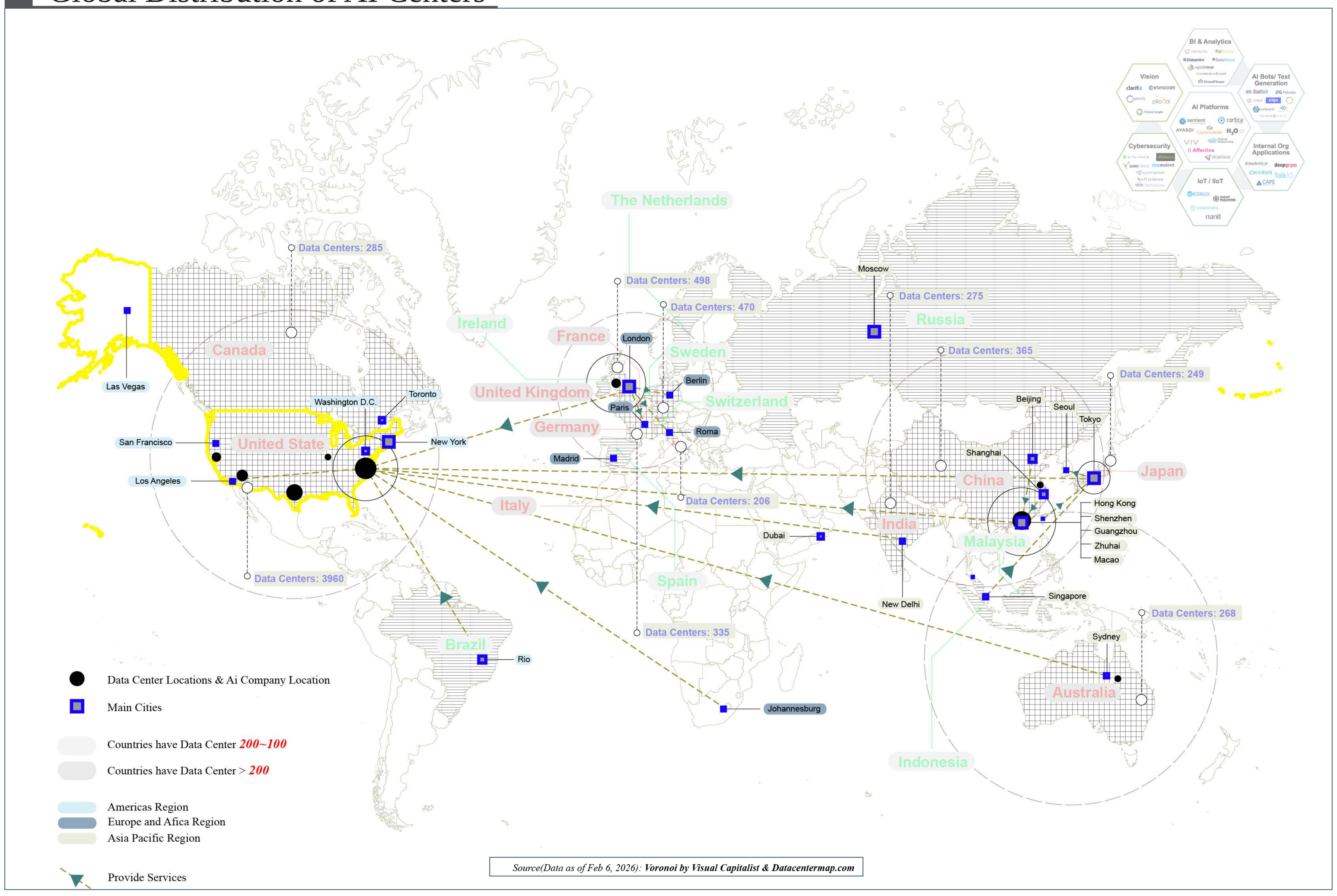
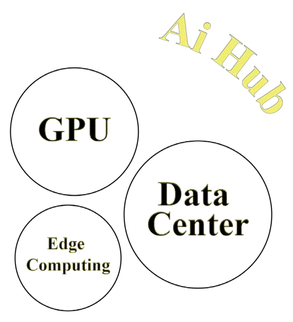
Global Distribution of AI Centers





By 2050, AI data centers are projected to undergo a profound transformation from predominantly privately owned corporate assets to essential public urban infrastructure, akin to electricity grids or water systems.
In the 2020s, hyperscale facilities owned by a handful of tech giants (Google, Microsoft, Amazon, Meta) dominated the landscape. These centralized "AI factories" delivered massive computational power but triggered severe sustainability challenges: skyrocketing energy consumption (potentially accounting for 8–20% of global electricity growth by 2030), enormous water use for cooling, land-intensive footprints, and growing community resistance over grid strain and carbon emissions.
As AI becomes deeply embedded in daily urban life — powering real-time traffic optimization, personalized public services, ecological monitoring, and edge inference — the limitations of corporate monopoly become untenable. High latency, privacy risks, and unequal access further highlight the need for change.
The shift is driven by several converging forces: edge computing and decentralized physical infrastructure networks (DePIN) enable distributed, low-latency processing closer to users; advances in energy-efficient hardware and liquid/sea-water cooling reduce environmental footprints; and governance models incorporating blockchain, DAOs, and public-private partnerships promote transparency and community oversight.
By mid-century, AI infrastructure evolves into a hybrid public utility: core training may remain in optimized regional hubs, while inference and local decision-making occur through modular, city-embedded nodes. Governments and communities treat AI capacity as shared civic infrastructure, regulated for equity, carbon neutrality, and resilience. This transition ensures AI serves broad societal goals rather than narrow corporate interests, fostering more inclusive, sustainable, and adaptive cities.

AI Hub Characteristics

De-publicized Characteristics

Unlike traditional urban developments, these hubs prioritize operational security and environmental stability, resulting in a controlled-access morphology. This design logic effectively decouples the facility from the public realm, establishing an autonomous technical zone that maintains strict physical boundaries
boundaries to ensure the uninterrupted performance of large-scale computational assets. to ensure the uninterrupted performance of large-scale computational assets.

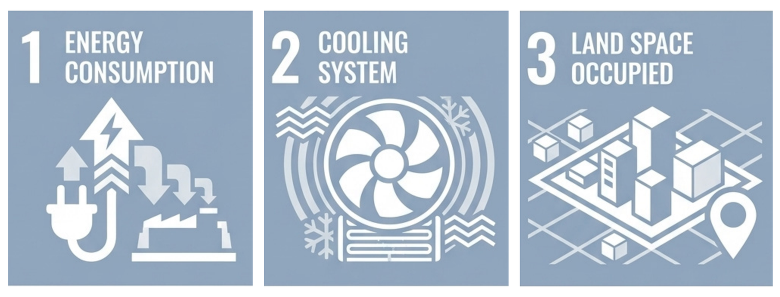
Peripheral Distribution

This spatial strategy involves the strategic siting of facilities within the urban fringe hinterlands. Driven by the need for extensive land footprints and proximity to high-capacity utility corridors, AI hubs gravitate toward these low-density zones. The vast spatial demands of large-scale computational infrastructure are significant.

Super-scale Land Use

This characteristic reflects the extensive spatial requirements inherent to AI infrastructure. To accommodate massive server arrays and their necessary cooling systems, these hubs adopt a horizontal expansion model, resulting in a significant physical footprint. This land-intensive approach prioritizes operational scalability over urban density, defining the site as a dedicated computational territory rather than a traditional mixed-use development.

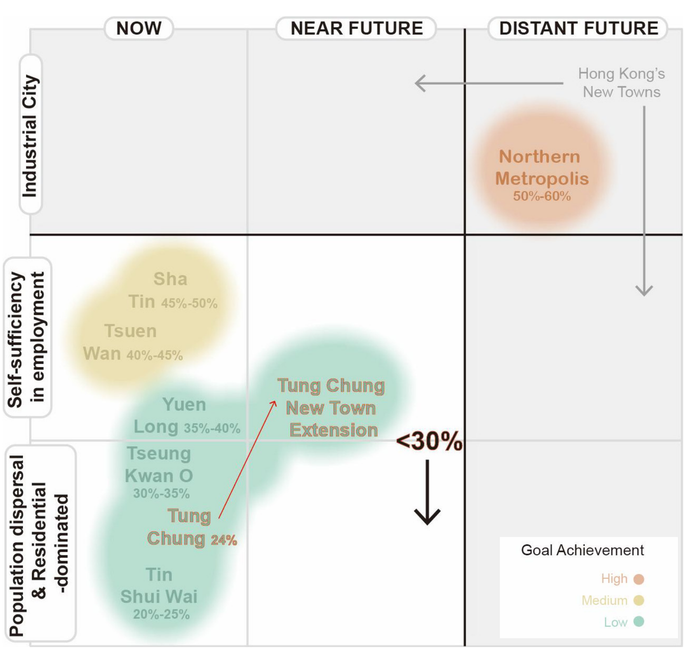
AI Hub Resource Demands



The AI Hub, as a physical urban facility, demands substantial energy, advanced cooling systems, and significant land area. High-performance computing clusters consume massive electricity for continuous operation, while intensive heat generation requires efficient cooling infrastructure, traditionally relying on large volumes of water or energy-intensive air conditioning. Additionally, hyperscale data centers occupy extensive land, exacerbating urban land scarcity. These requirements highlight the limitations of conventional centralized AI facilities and underscore the necessity for innovative solutions that minimize energy use, optimize cooling, and reduce land footprint.

Location

The proportion of residents working



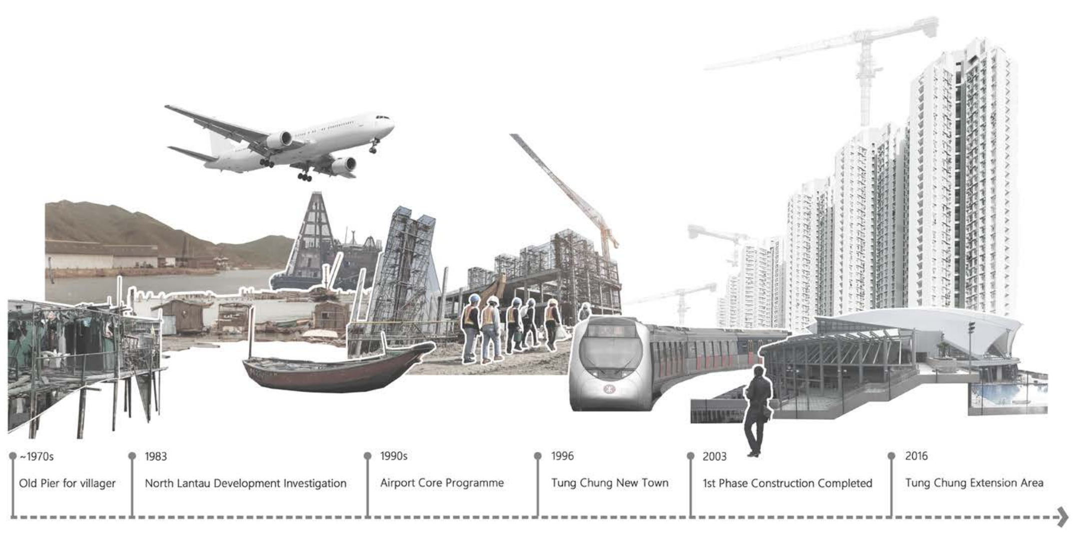
Adapted from:
GovHK Fact Sheet "New Towns, New Development Areas and Urban Developments" (CEDD, 2021);
Hong Kong Housing Authority "Public Housing Development";
Town Planning Board "Green Belt" planning guidelines; Living with Statistics 2025 Editio

Hong Kong New Town Planning Objectives:

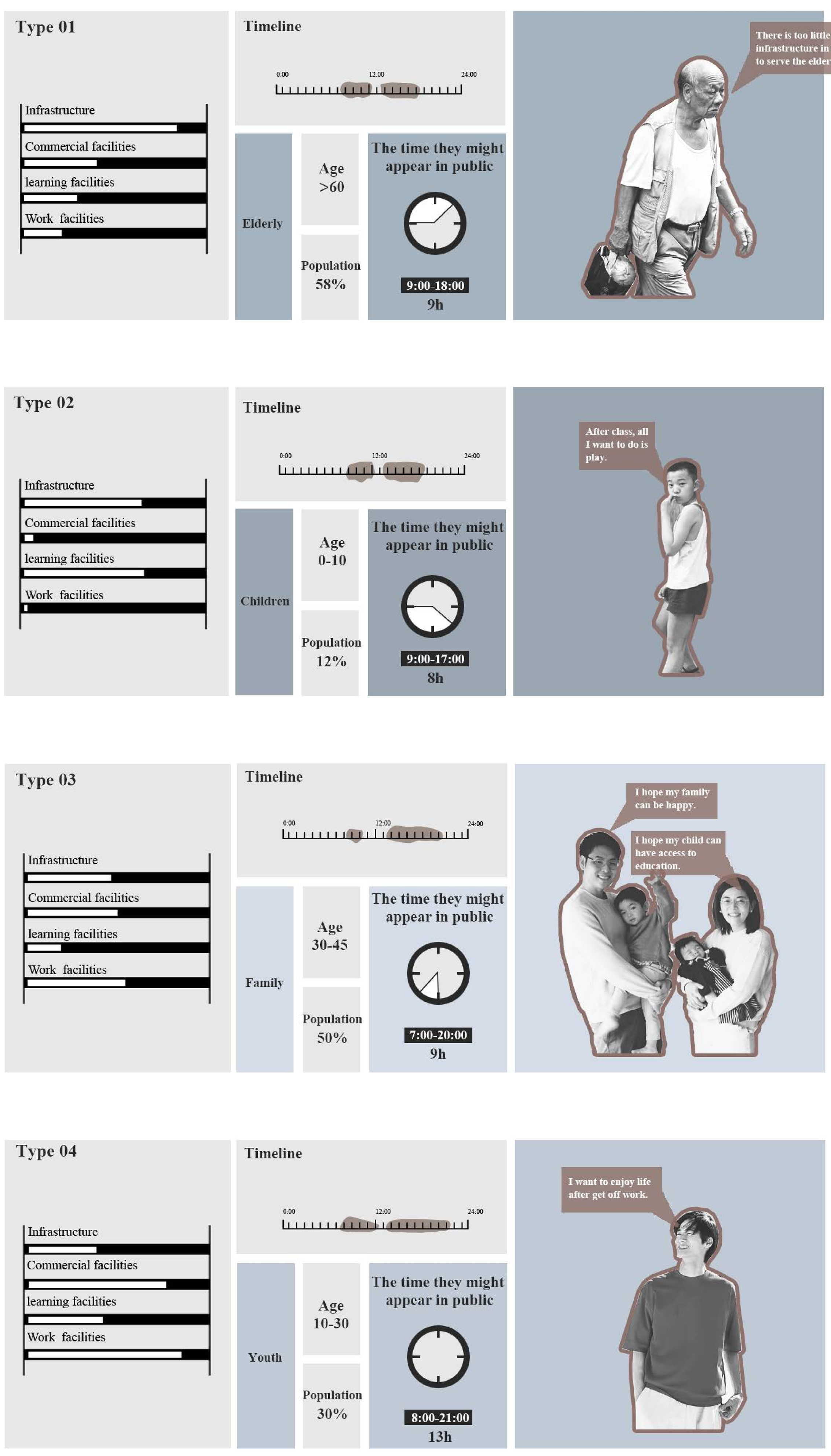
1. Decentralize population from urban core
2. **Provide self-contained communities**
3. Large share of public housing
4. Integrate with rail and road networks
5. Protect country park & green belts

Tung Chung was developed as Hong Kong's third-generation new town under the 1990s Airport Core Programme. Launched in 1992 to house airport-related workers and relieve population pressure from Hong Kong Island and Kowloon, the town was built on reclaimed land along Tung Chung Bay. The first phase was completed by 1998, creating a high-density residential satellite supported by the Airport Express and North Lantau Highway. However, it has long suffered from severe job-housing imbalance and limited daytime vitality. By 2050, Tung Chung should evolve beyond its dormitory-town model into a vibrant, resilient, and smart marine-oriented hub. Integrating floating AI-centric islands for public services, ecological research, commercial vitality, and clean energy will achieve job-housing balance, enhance urban liveliness, and foster sustainable blue-economy growth while complementing the existing land-based community.

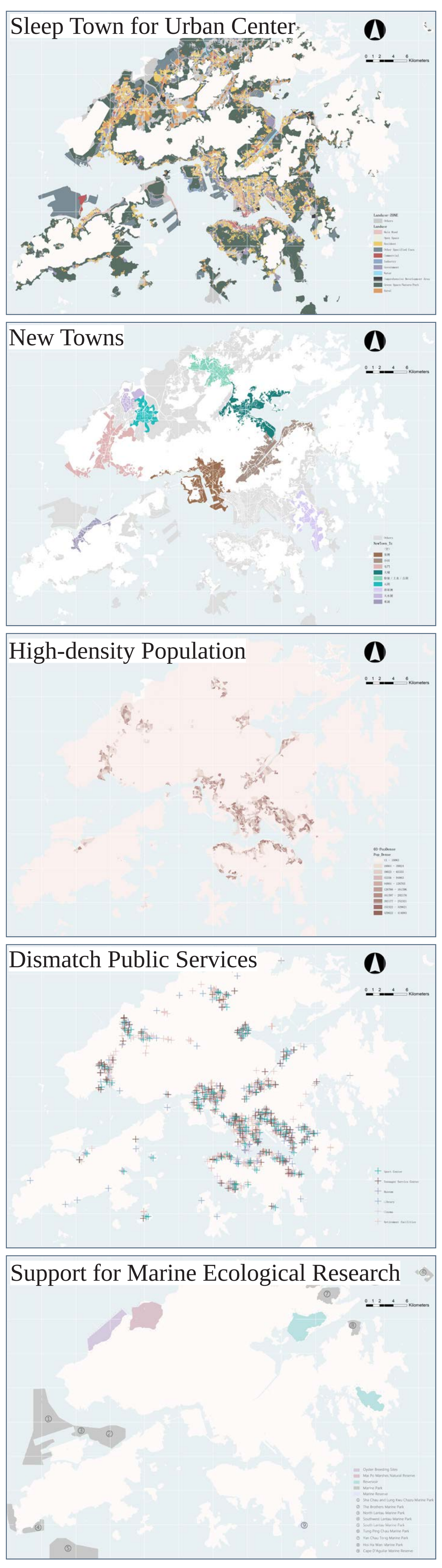
Tung Chung currently a sleeping town



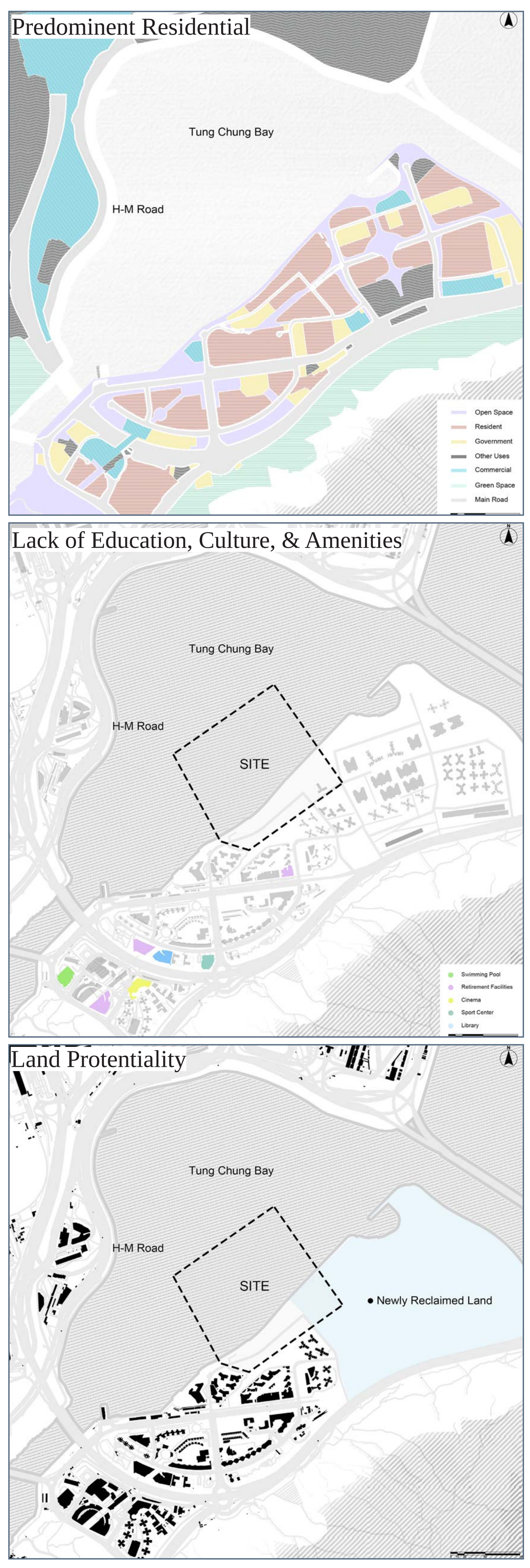
Diverse Demands in 2050



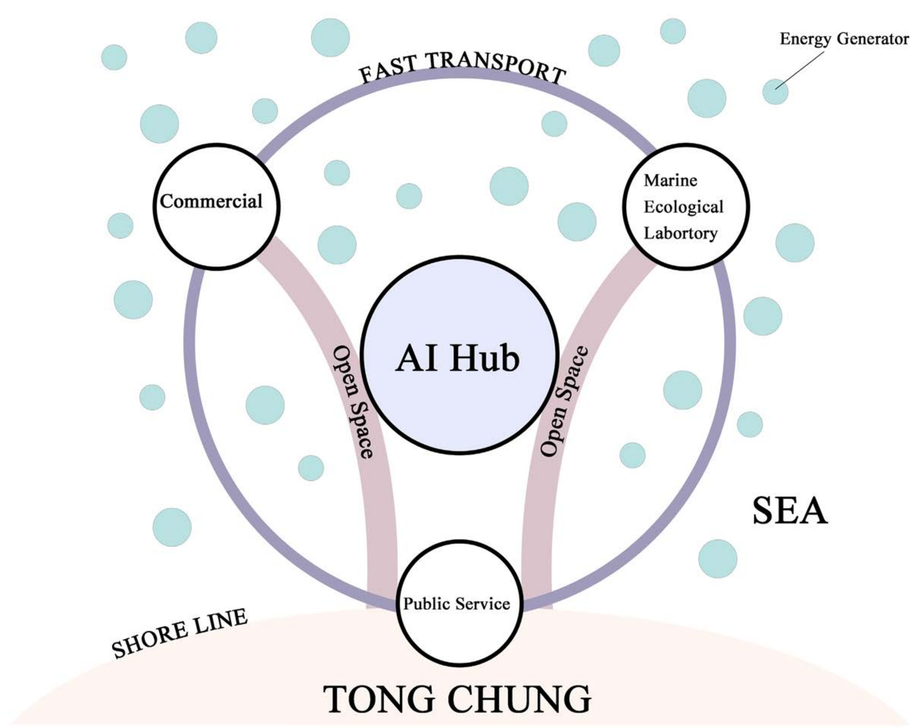
Macro-scale



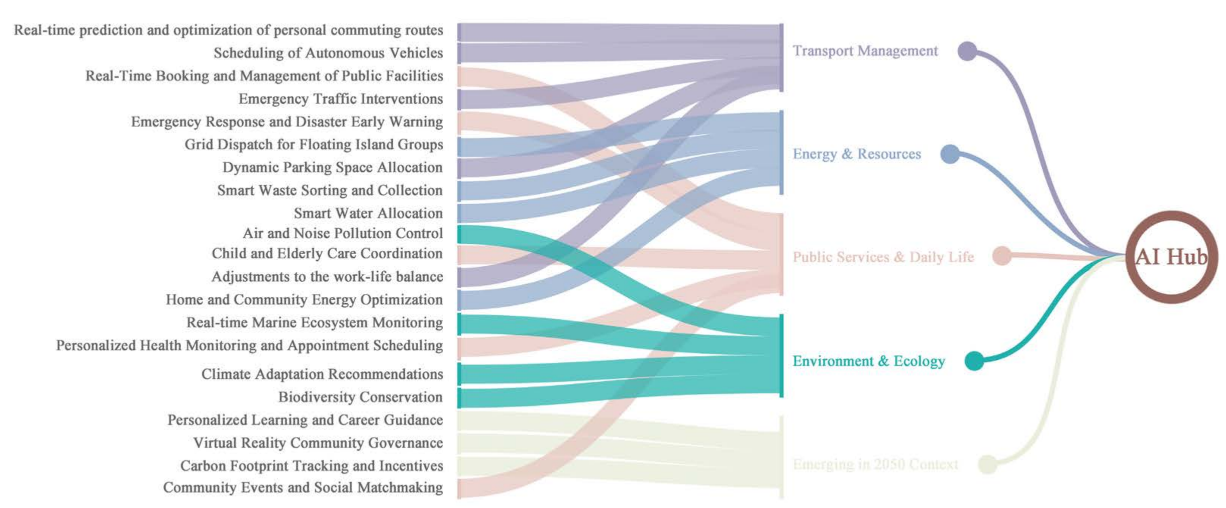
Meso-scale



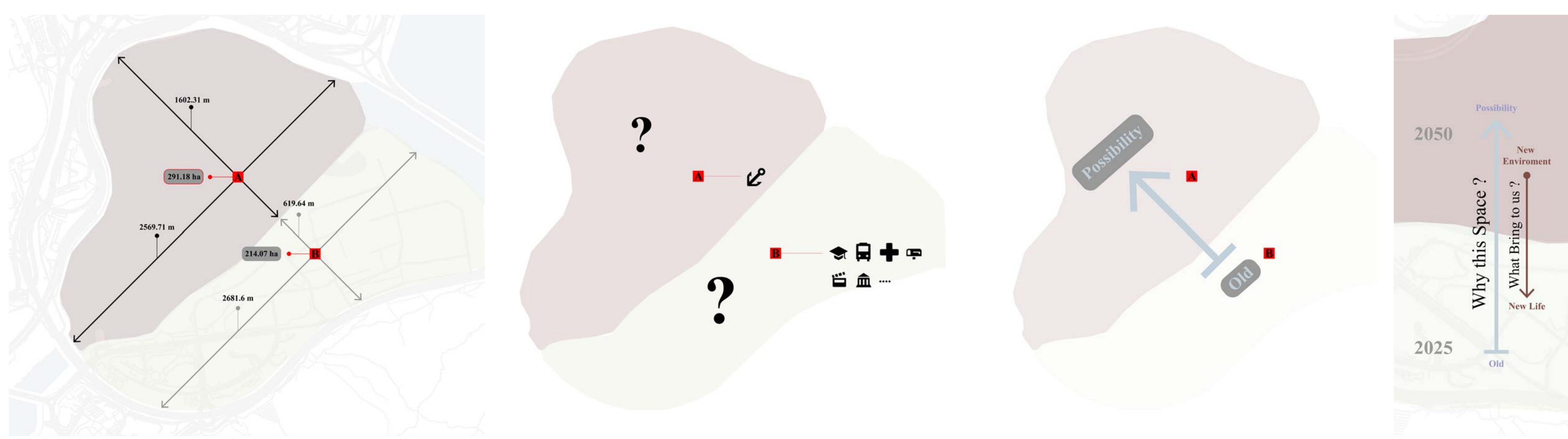
Concept: Floating Island + AI Hub



The conceptual framework is anchored by a central AI Hub floating island that functions as the intelligent core of the modular archipelago. Surrounding this hub, specialized floating modules are implanted with complementary urban functions: public service facilities for healthcare and education, a dynamic commercial center for retail and cultural activities, and an ecological research laboratory focused on marine biodiversity and climate adaptation. These functional nodes are efficiently interconnected by a high-speed elevated circular transit ring, enabling rapid, seamless movement across the entire floating city. Encircling the system are free-floating solar energy generator islands that autonomously reposition to maximize solar capture and supply clean power to the network. This AI-centric floating ecosystem directly addresses Tung Chung's challenges of land scarcity and daytime vitality deficit while creating a symbiotic relationship with the existing land-based community, forming a hybrid, resilient urban model that blends advanced technology, ecological intelligence, and enhanced livability for 2050.

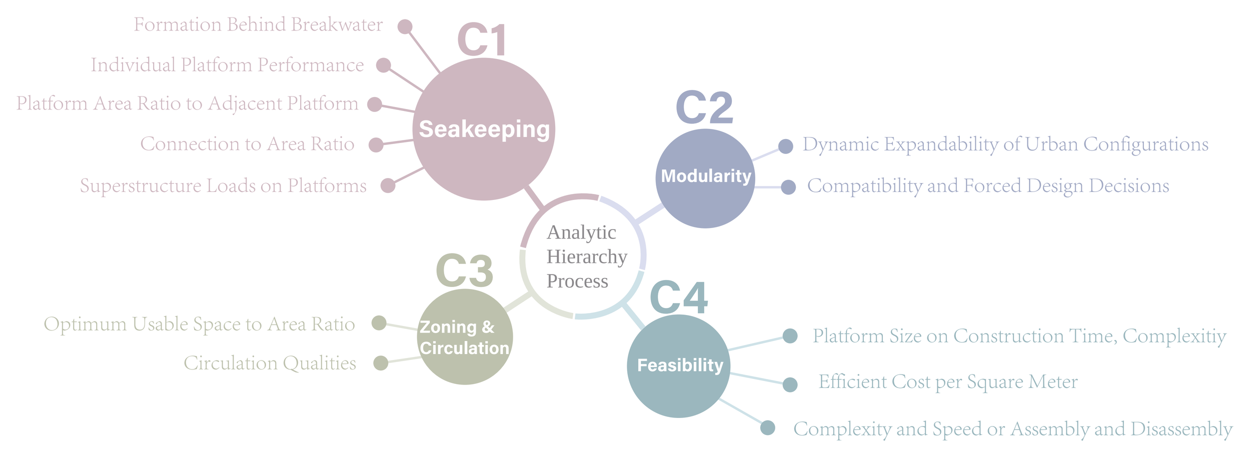


Possibility on the sea?



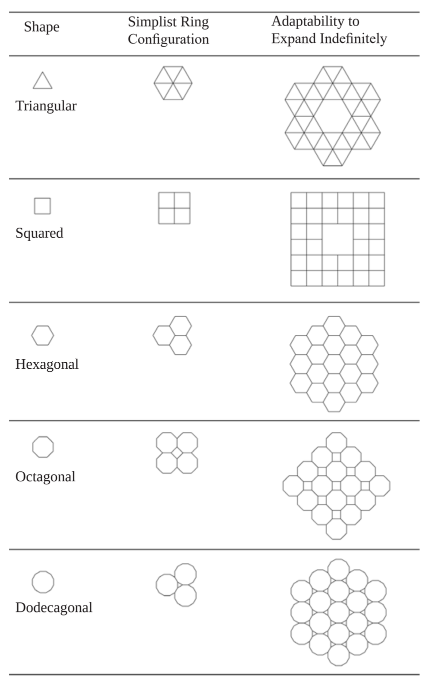
The vast sea surface around Tung Chung offers immense untapped potential for sustainable urban expansion. Through modular floating islands, this underutilized marine space can be transformed into a vibrant, multi-functional extension of the city without consuming scarce terrestrial land. Central AI Hub islands, public service platforms, commercial centers, ecological research laboratories, and free-floating solar energy generators can be strategically deployed to generate clean power, monitor marine biodiversity, and deliver essential services. High-speed elevated circular transit and autonomous vessels ensure seamless connectivity, while adaptive docking systems allow flexible reconfiguration. This innovative sea-space utilization creates a resilient, symbiotic hybrid urban system that complements Tung Chung's existing land community and adapts to sea-level rise by 2050.

Research on Floating Island Shape

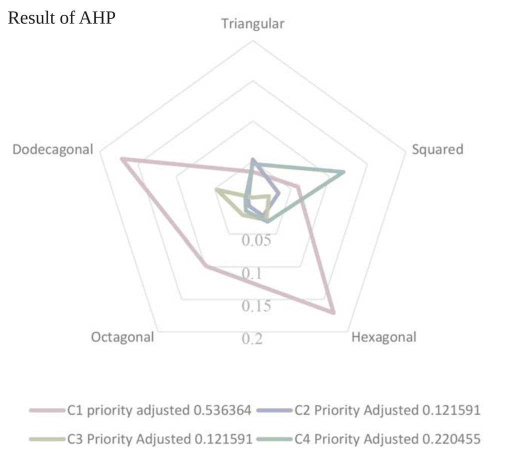


This paper proposes a systematic approach for designing modular floating cities using Euclidean tilings (regular, semi-regular, and demi-regular) to overcome previous limitations in interlocking capabilities and space utilization. It evaluates five platform shapes — triangular, squared, hexagonal, octagonal, and dodecagonal — through a mixed-method framework combining literature review, expert brainstorming (Group Decision Making), and the Analytic Hierarchy Process (AHP). Four key criteria are prioritized: seakeeping (53.6% weight), feasibility (22%), modularity (12.2%), and zoning/circulation (12.2%).

After pairwise comparisons and consistency checks, the hexagonal platform ranks highest (25.31%), followed by dodecagonal and squared platforms. The study demonstrates how these shapes enable unlimited dynamic configurations, including ring and linear expansions, without forced gaps or wasted space. The research offers practical design considerations for architects and planners, emphasizing adaptability, stability, and sustainable expansion. It positions the ETFPC (Euclidean Tiling for Floating Platform Configuration) approach as a flexible, context-specific solution for climate-adaptive floating cities.



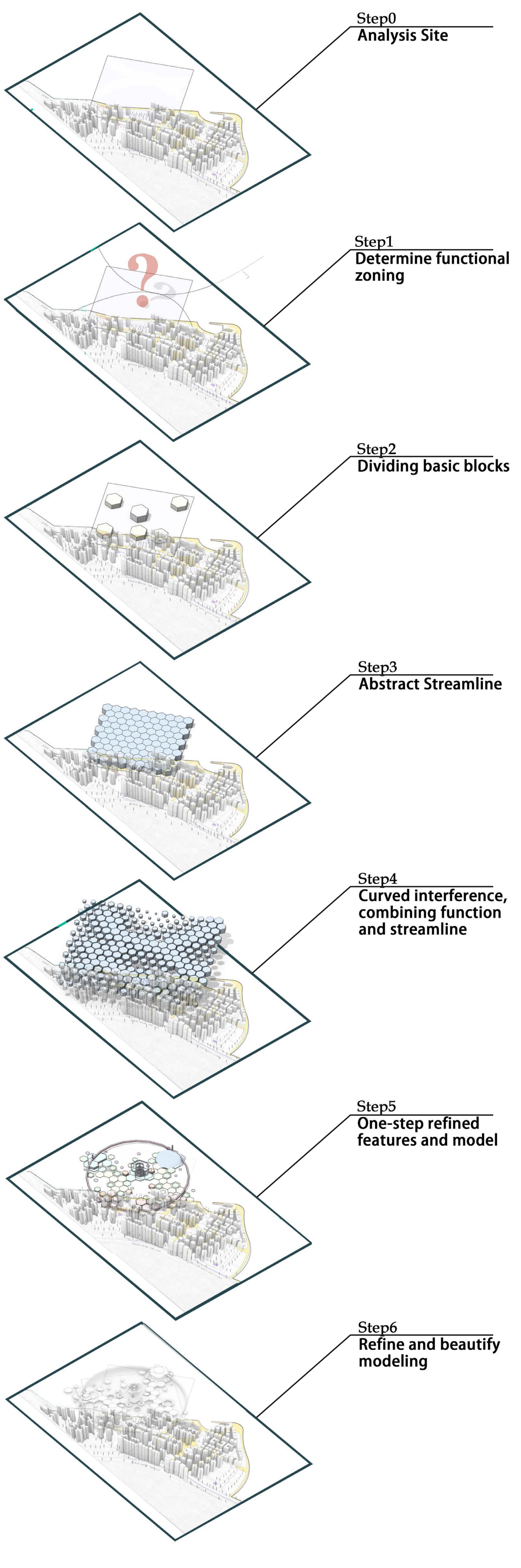
Result of AHP



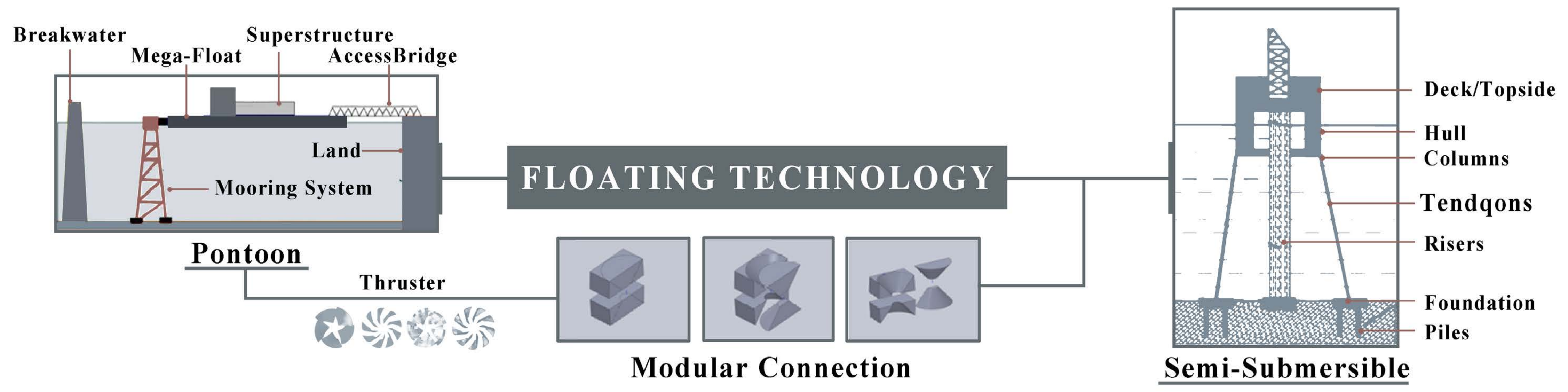
Hexagonal platform reaches the highest score

		C1 priority adjusted 0.536364	C2 Priority Adjusted 0.121591	C3 Priority Adjusted 0.121591	C4 Priority Adjusted 0.220455	Average adjusted
1	Triangular	0.036834	0.052073	0.004625	0.046501	**0.140034**
2	Squared	0.059005	0.033742	0.020972	0.11854	0.232258
3	Hexagonal	0.170887	0.022337	0.028588	0.031327	**0.253139**
4	Octagonal	0.098752	0.007373	0.020972	0.014485	0.141581
5	Dodecagonal	0.170887	0.006066	0.046434	0.009601	0.232988

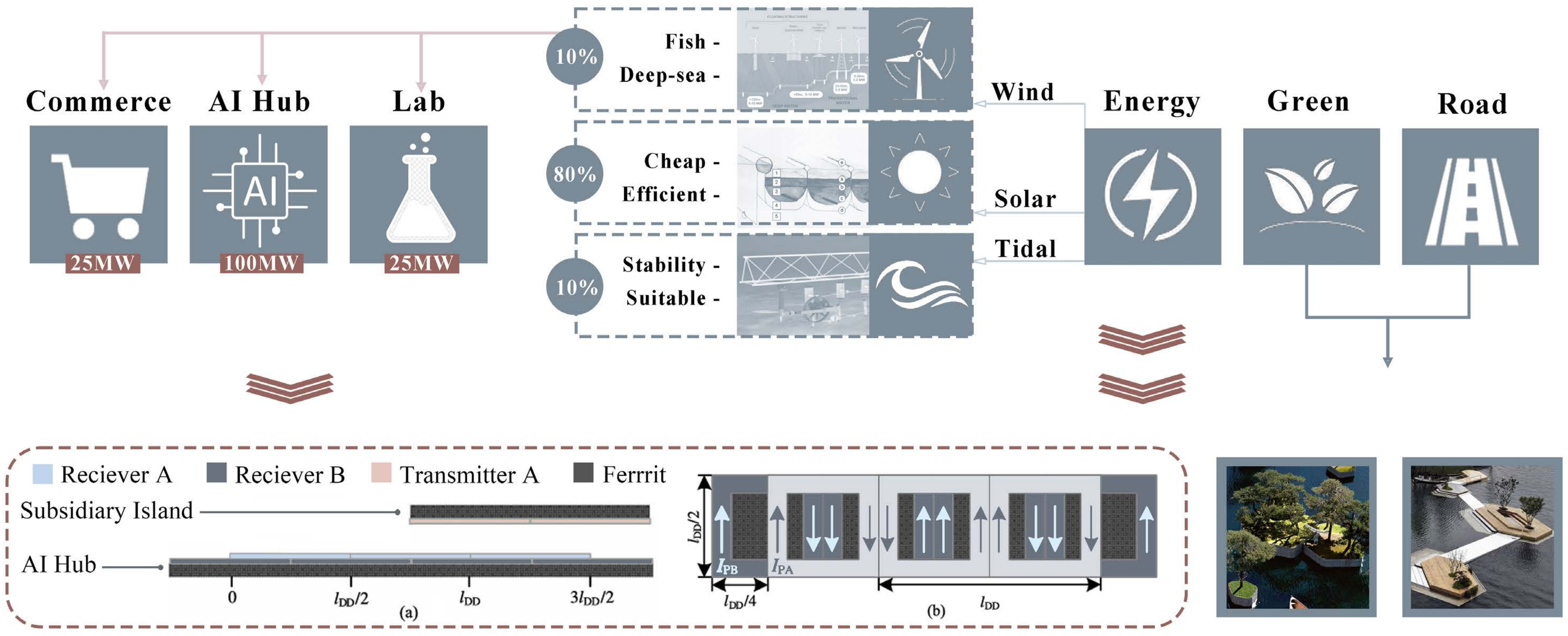
Process of Generation



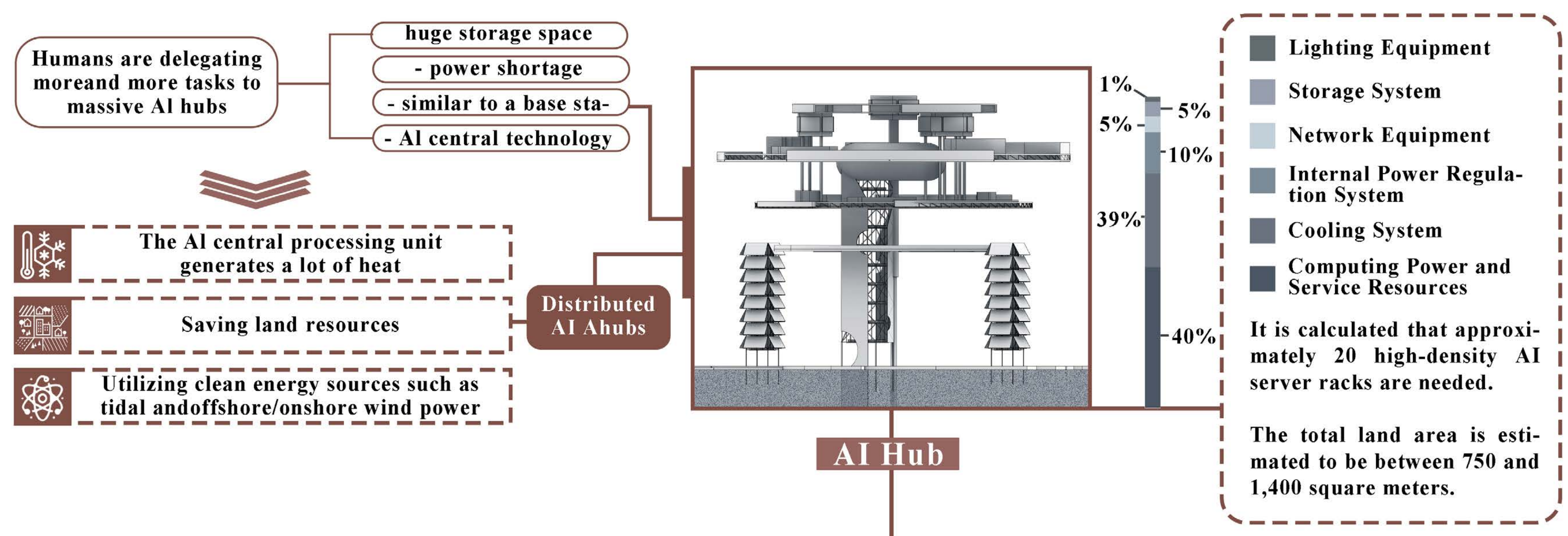
Types of Floating Islands



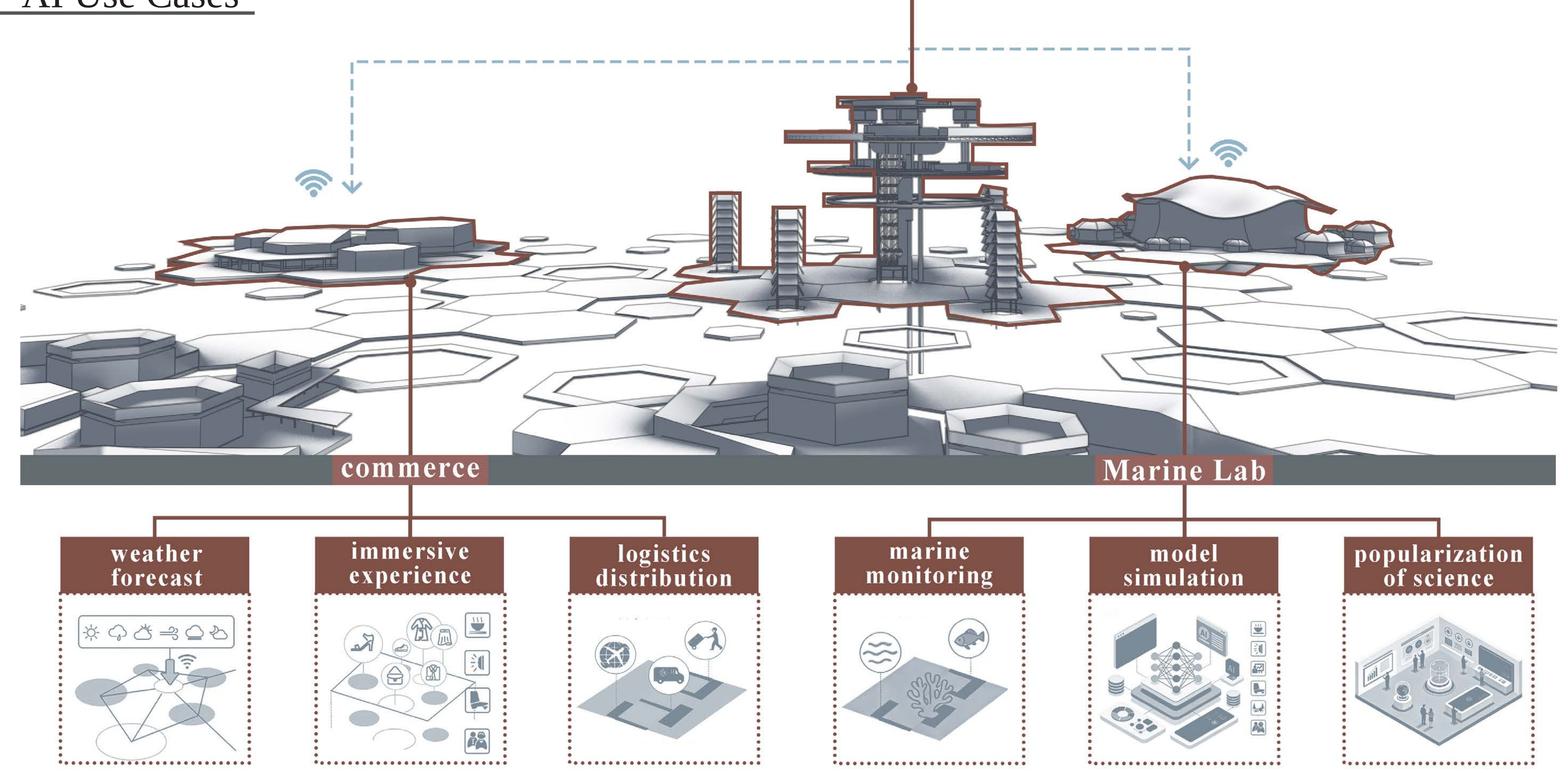
Clean Energy Types



AI Hub Energy Demands



AI Use Cases



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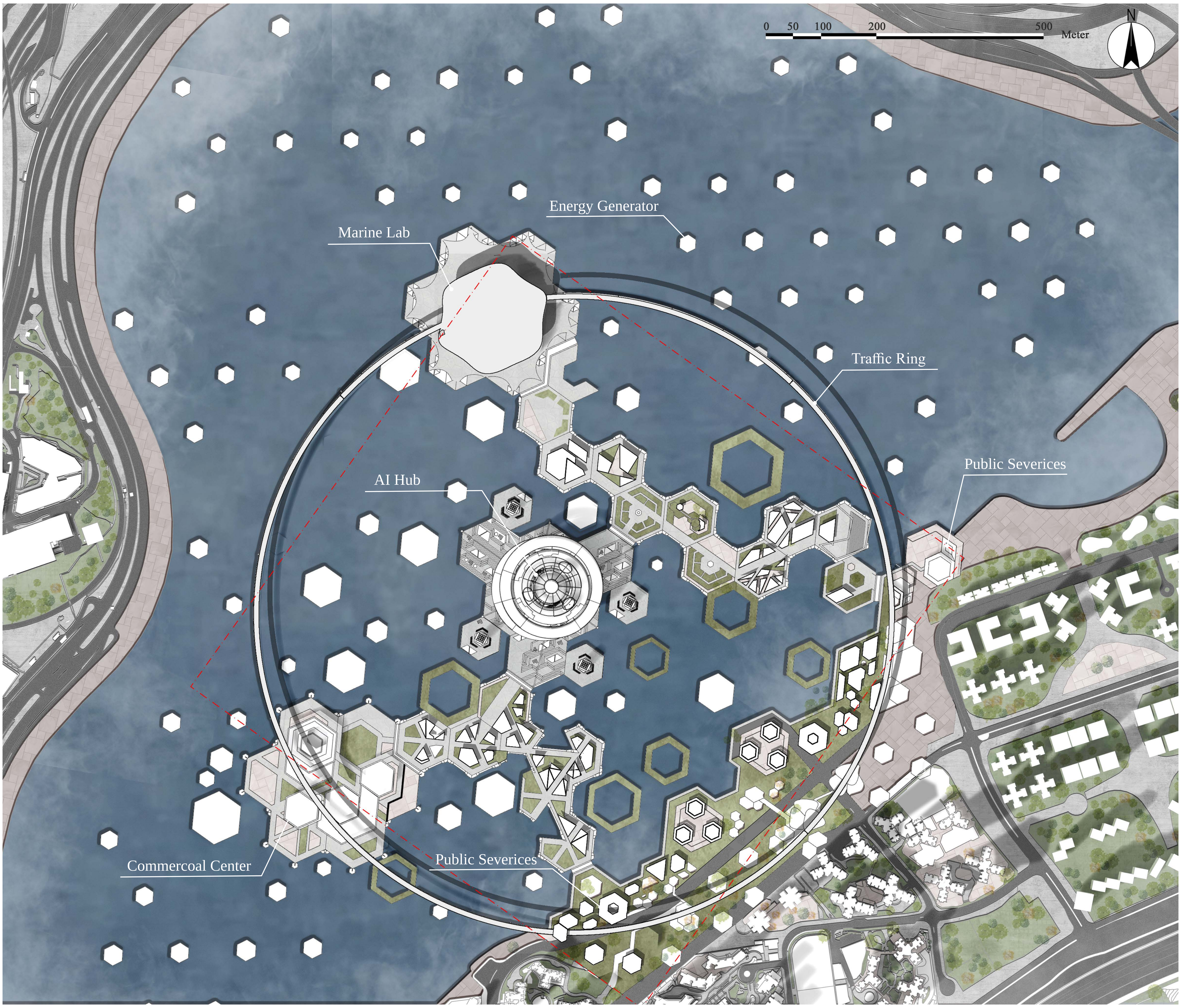
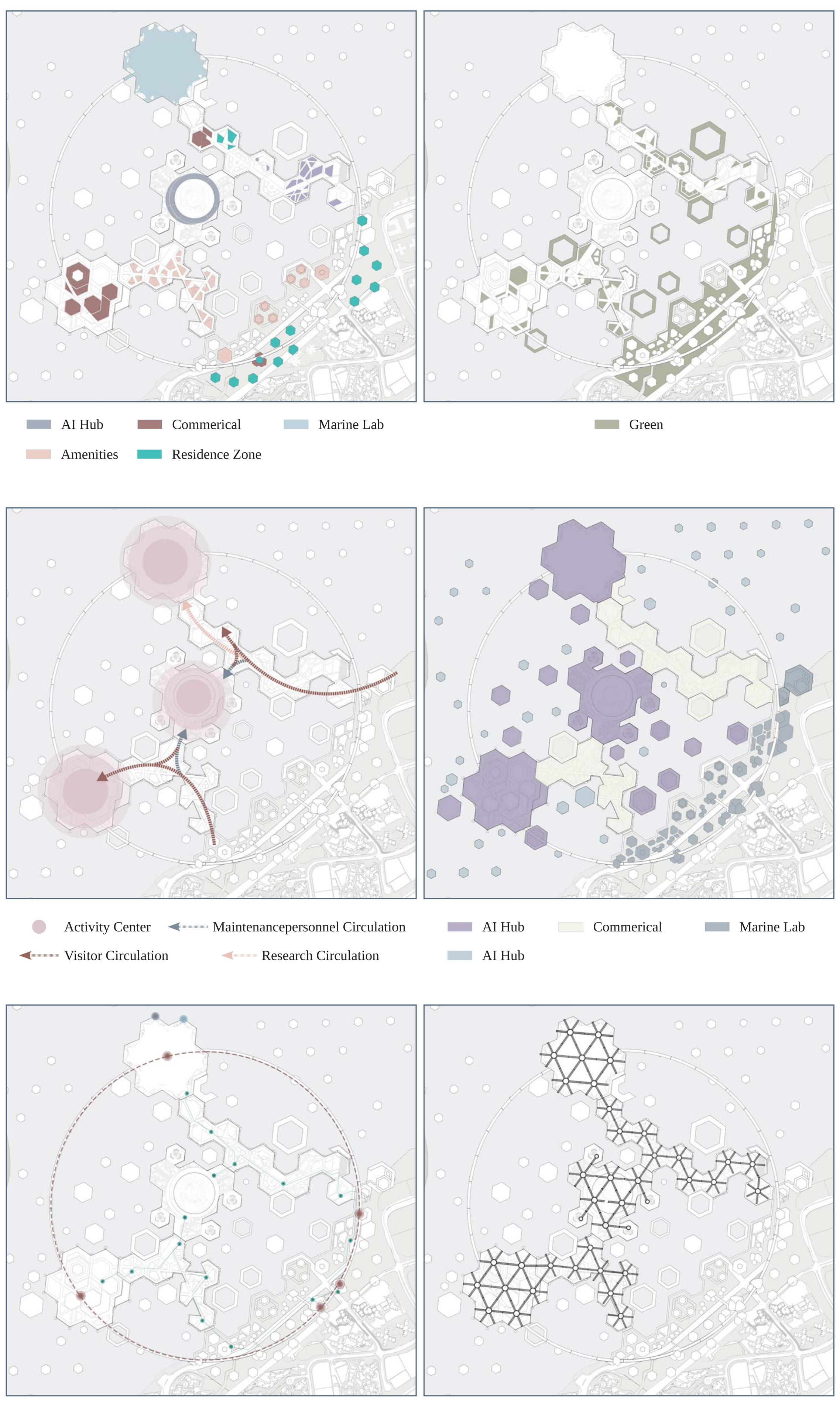
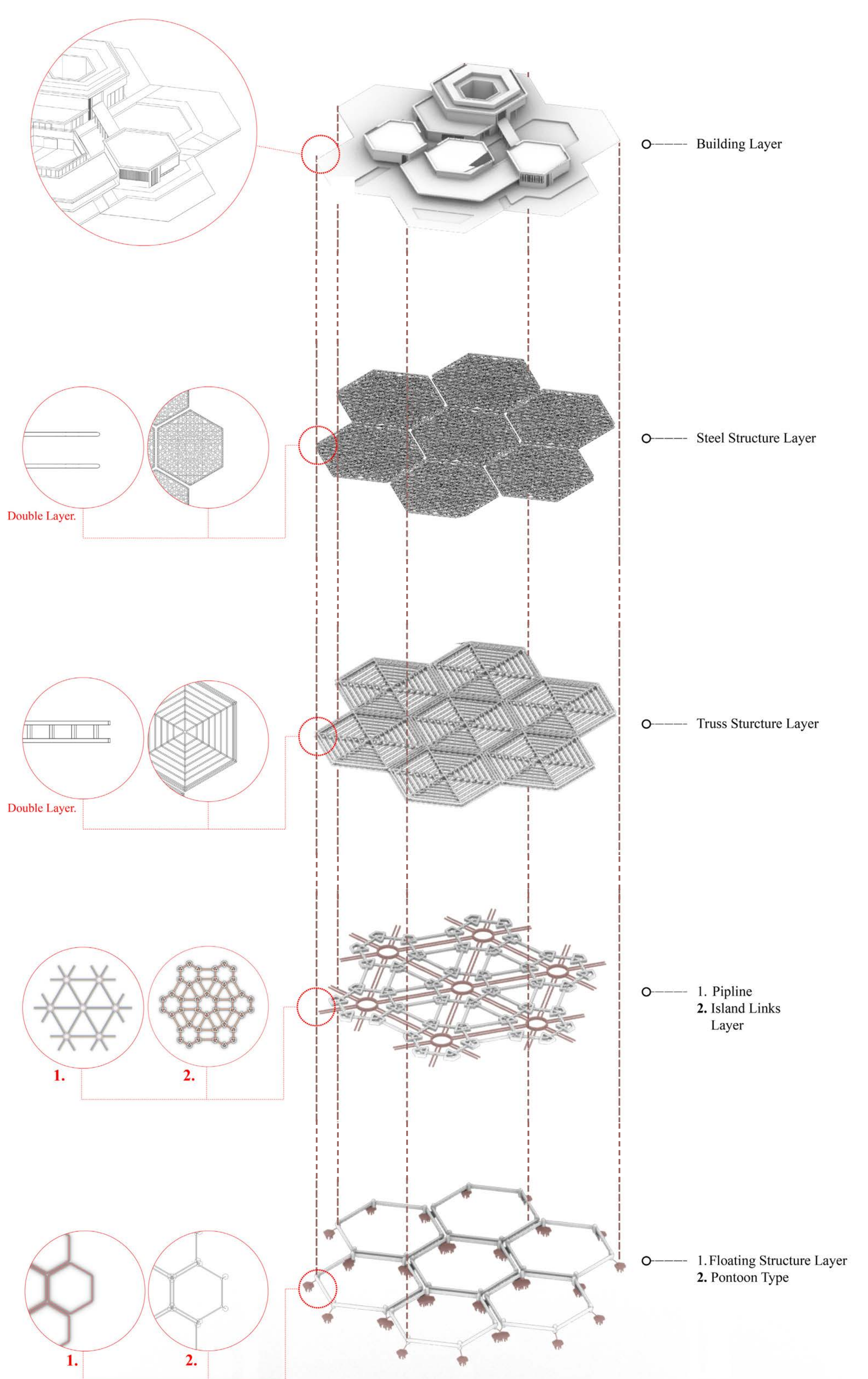


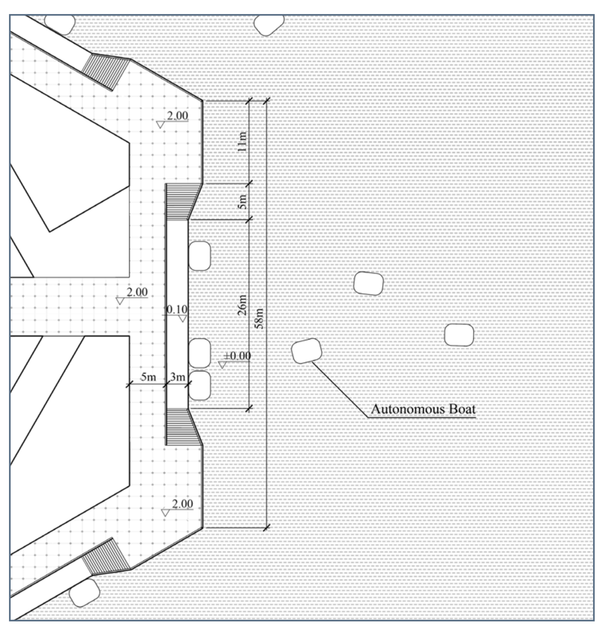
Systems Diagram



Floating Island Structure

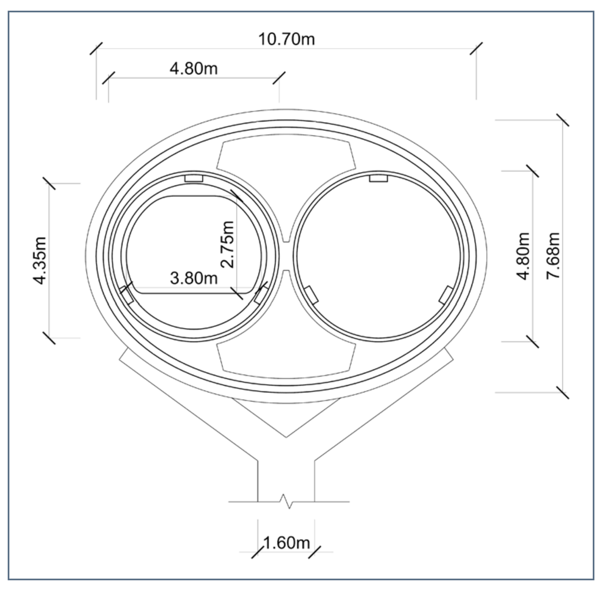


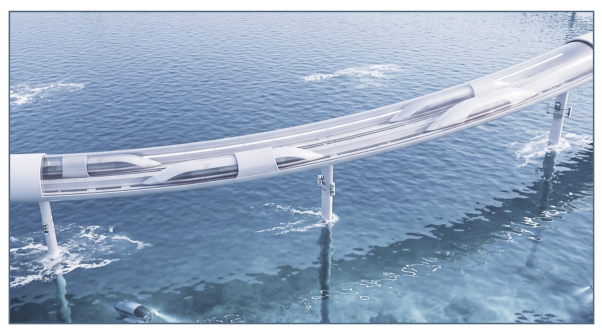
Adaptive Doking Port



Each floating island module is equipped with adaptive docking ports along its entire perimeter, enabling seamless and flexible berthing. These smart docking systems feature sensor-guided, self-adjusting fenders and retractable gangways that automatically align with approaching autonomous vessels. Passengers can freely move between islands using driverless electric boats without needing fixed terminals. The AI Hub coordinates real-time navigation, ensuring safe and efficient transfers at any point along the edge. This innovative design eliminates waiting times at traditional docks, greatly enhances mobility within the archipelago, and supports spontaneous movement, significantly boosting daytime urban vitality in Tung Chung by 2050.

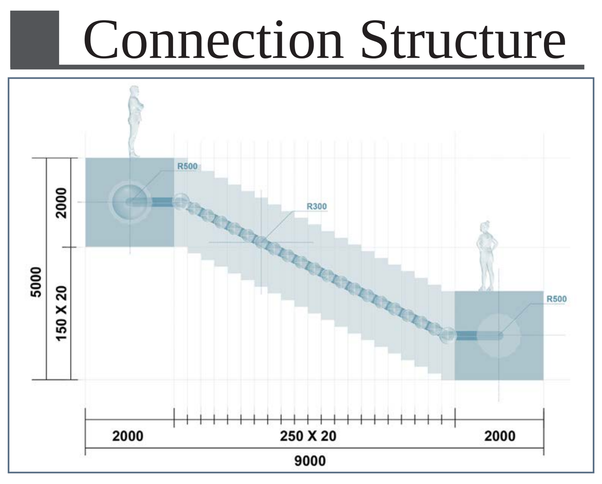
Section of Traffic Ring

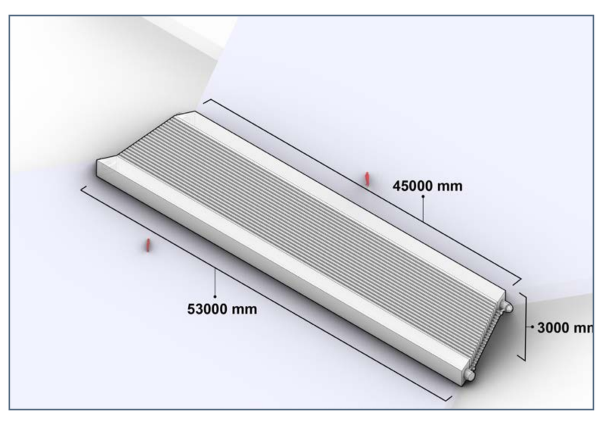




Encircling each floating island module is a high-speed elevated circular track with a 10-meter-diameter tubular profile. This orbital transit system enables rapid and efficient connections between all functional nodes within the AI Hub archipelago. Powered by magnetic levitation or linear induction motors, autonomous trains operate at speeds of 80–150 km/h, providing seamless ring-shaped mobility. Passengers can transfer effortlessly via retractable vertical connectors from the island surface directly into the elevated tube. Integrated with the AI Hub's intelligent scheduling, the system ensures minimal waiting times and supports dynamic island reconfiguration, dramatically enhancing connectivity and transforming the floating city into a highly accessible, vibrant urban network by 2050.

Connection Structure





To accommodate tidal fluctuations and future sea-level rise, flexible adaptive bridges connect fixed land platforms with floating islands. These articulated connection structures feature hinged joints and telescopic sections that automatically adjust in height and angle according to real-time water levels. Integrated hydraulic or pneumatic systems, guided by the AI Hub, ensure smooth and safe transitions.

The bridges maintain stable pedestrian and emergency vehicle access while absorbing wave movements and wind loads. This resilient design not only guarantees continuous connectivity across the archipelago but also enhances the system's long-term adaptability to climate change, allowing seamless movement between static coastal zones and dynamic floating modules.

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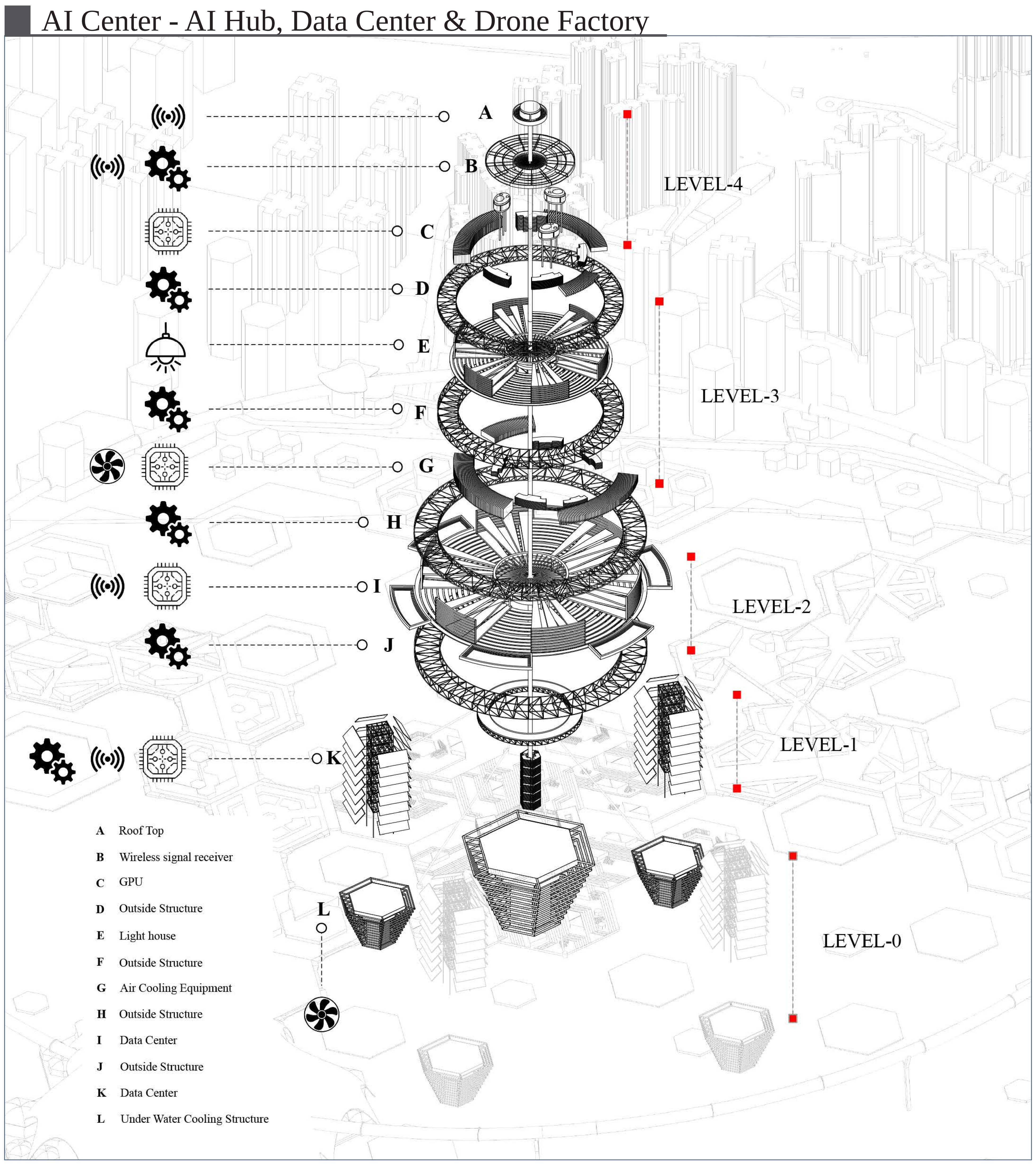
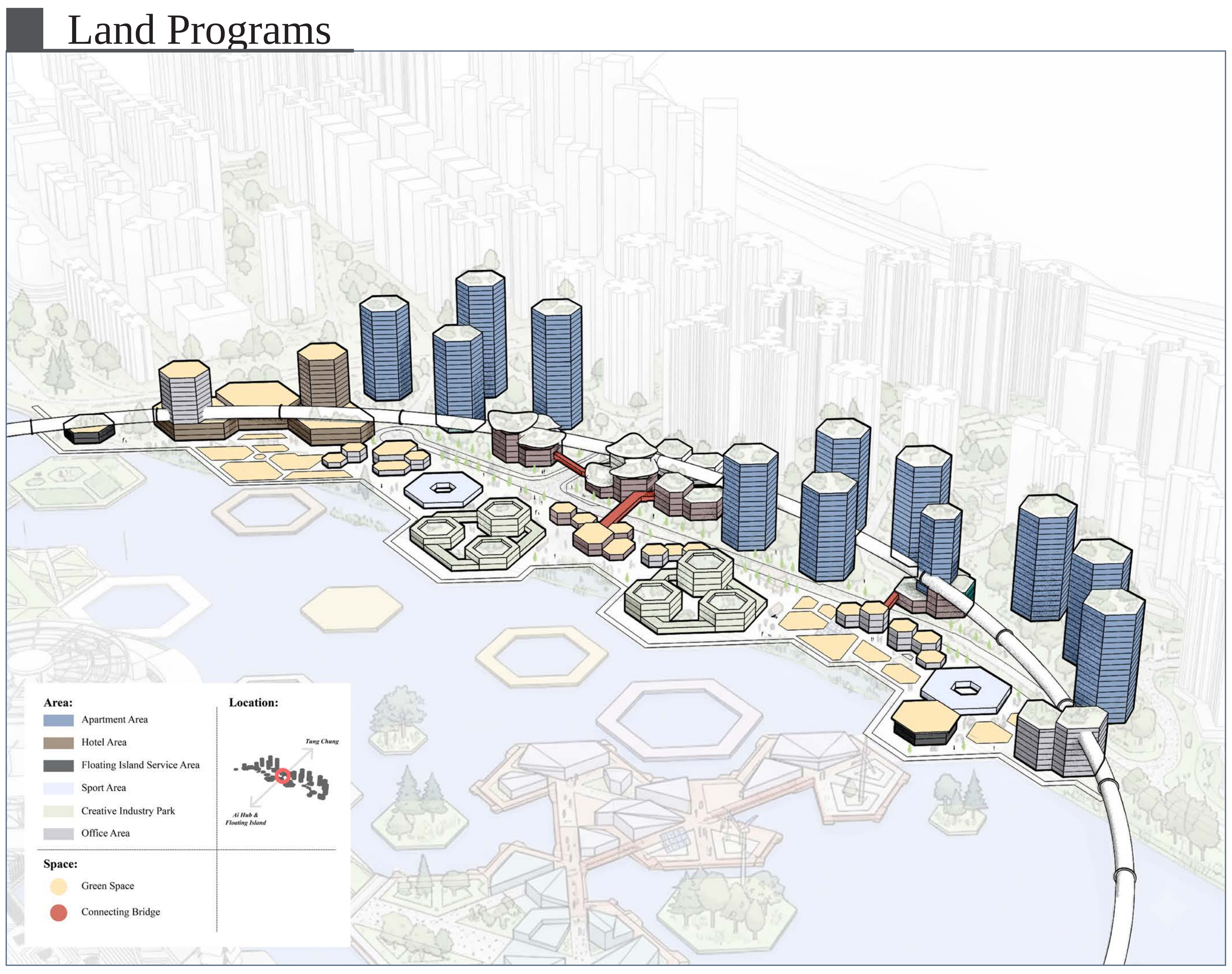
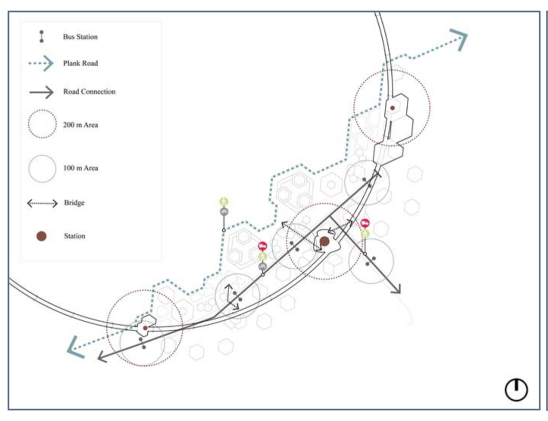
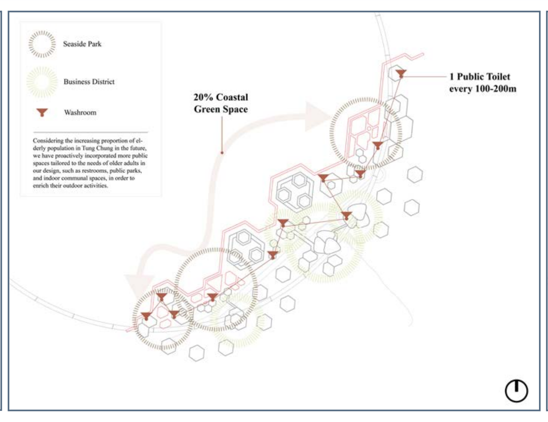
AI Center - AI Hub, Data Center & Drone Factory

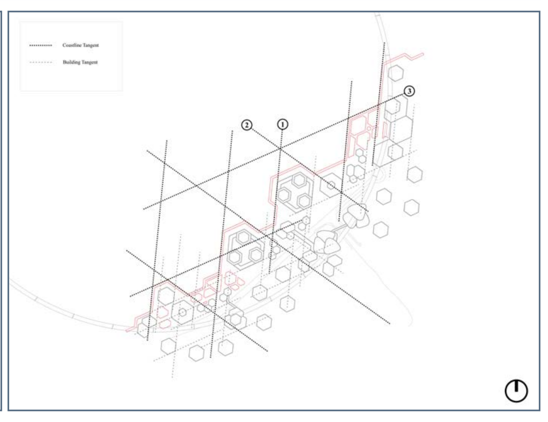


Land Programs

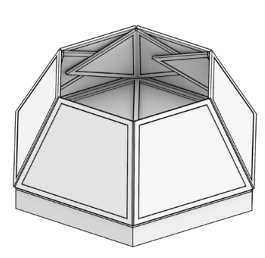








Floating Energy Generators



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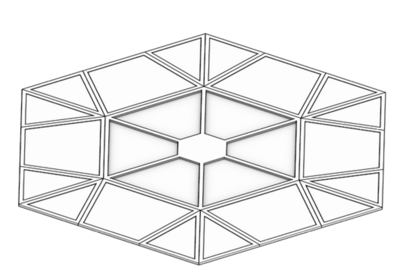

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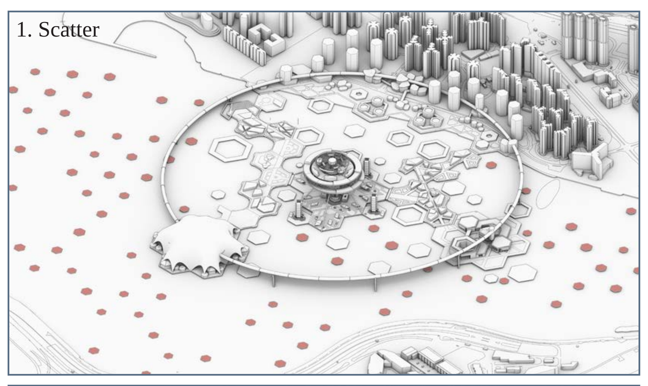

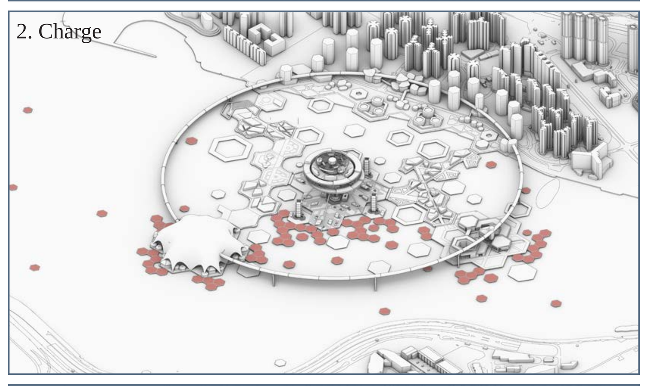

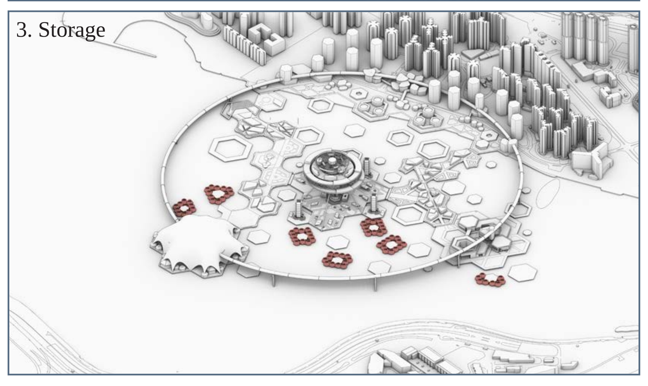

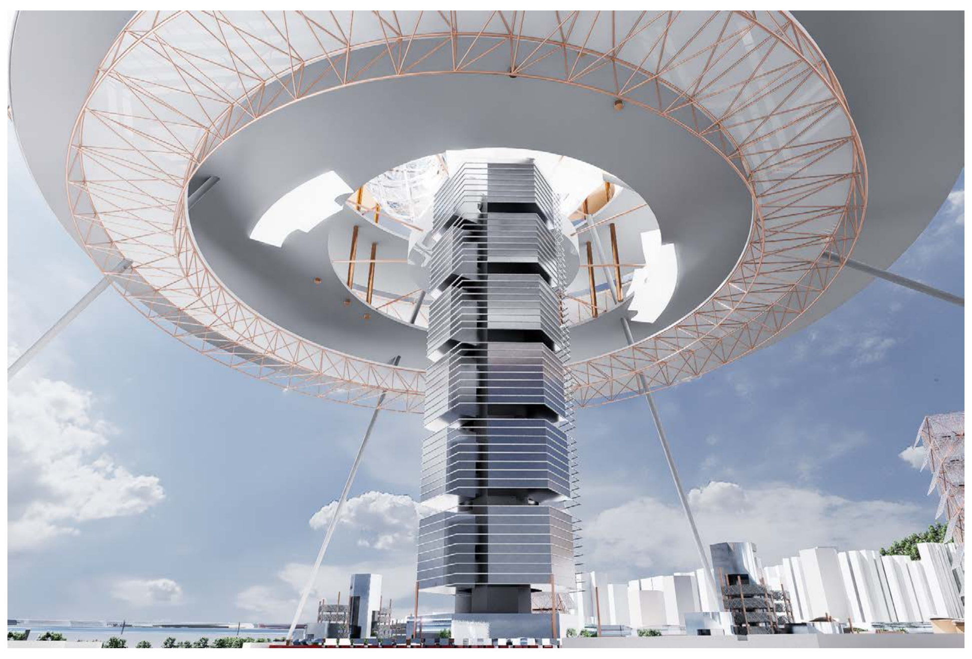

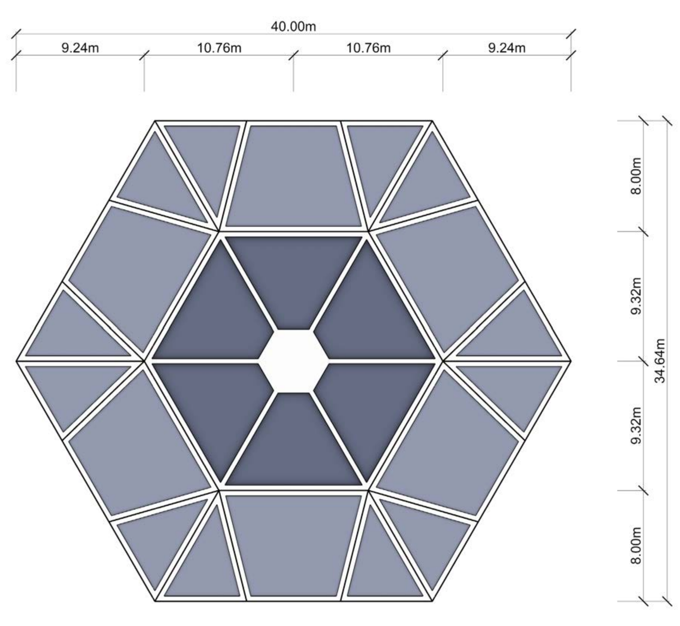

The solar energy generator floating islands are designed as modular, free-floating units that can autonomously adjust their position and orientation according to sunlight and weather conditions. Each island features a large deployable solar array on its upper surface, which unfolds like petals to maximize energy capture. Equipped with AI-controlled propulsion and dynamic anchoring systems, these generator islands can drift within a designated zone or cluster together to form larger energy hubs when needed. By utilizing sea-water cooling and flexible connections, they efficiently supply clean power to the AI Hub and surrounding functional islands while minimizing land use and adapting to tidal changes

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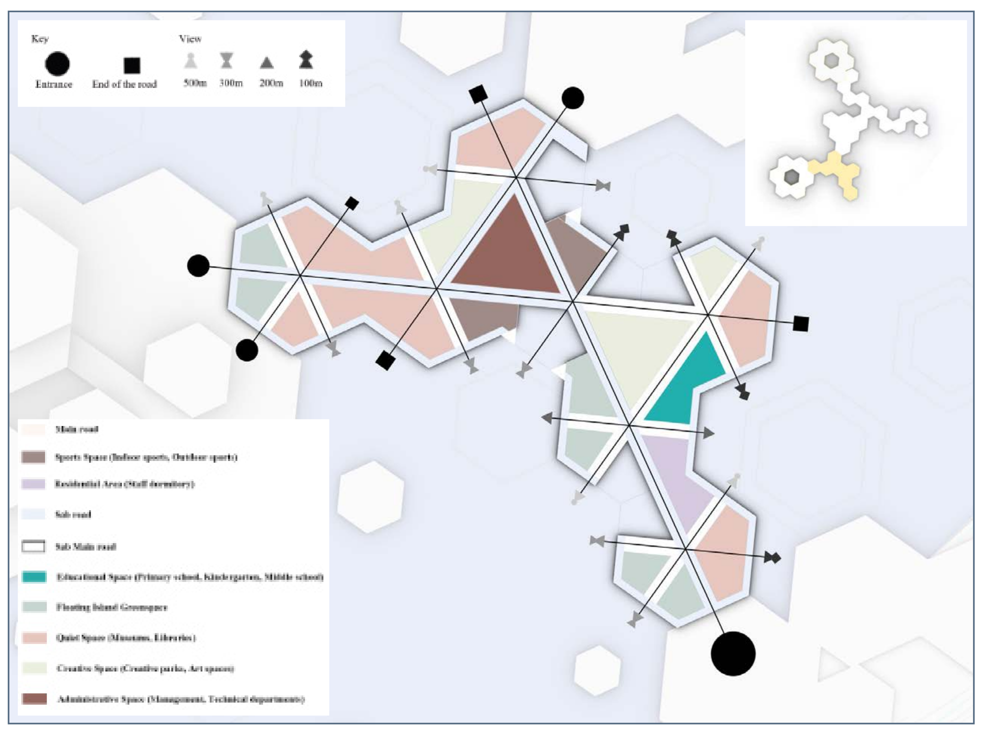
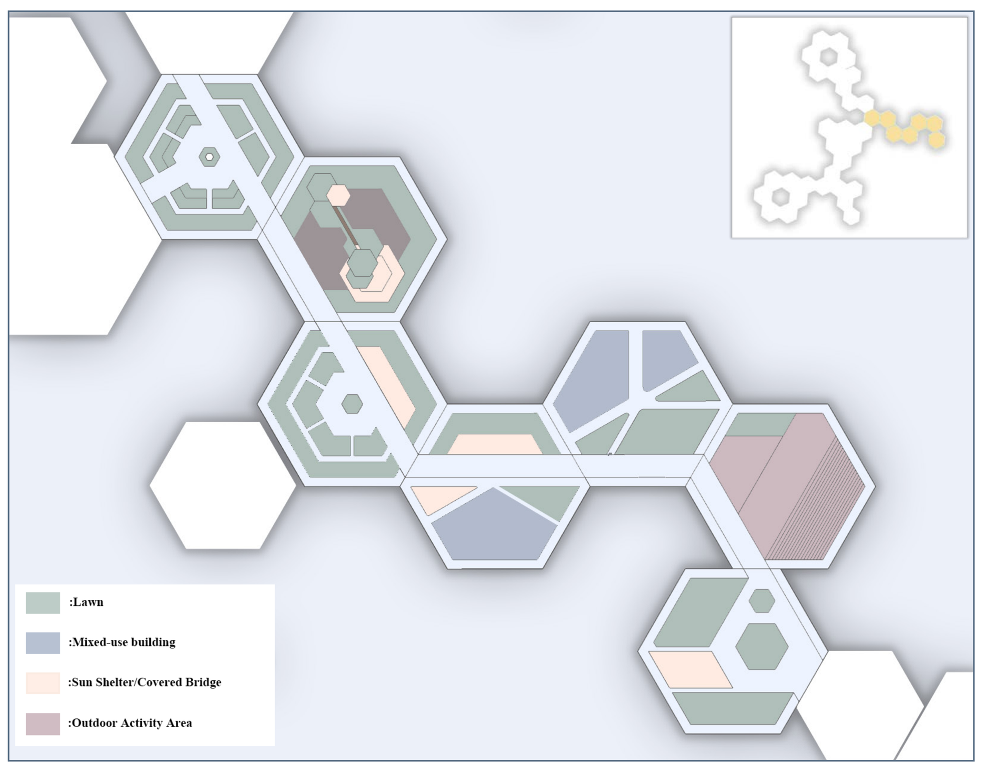
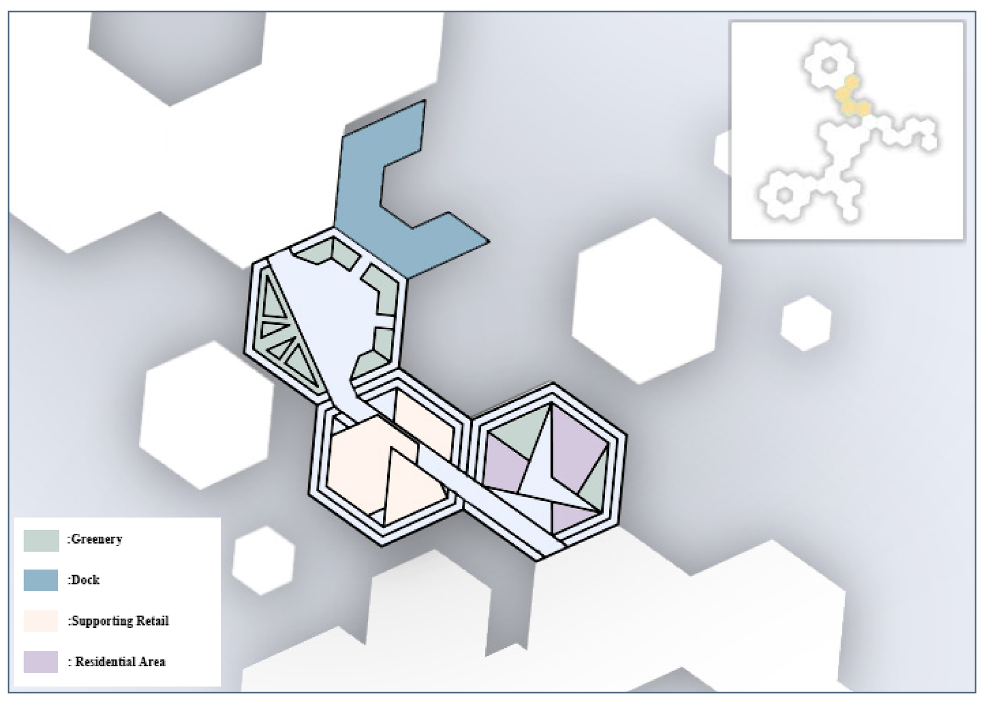
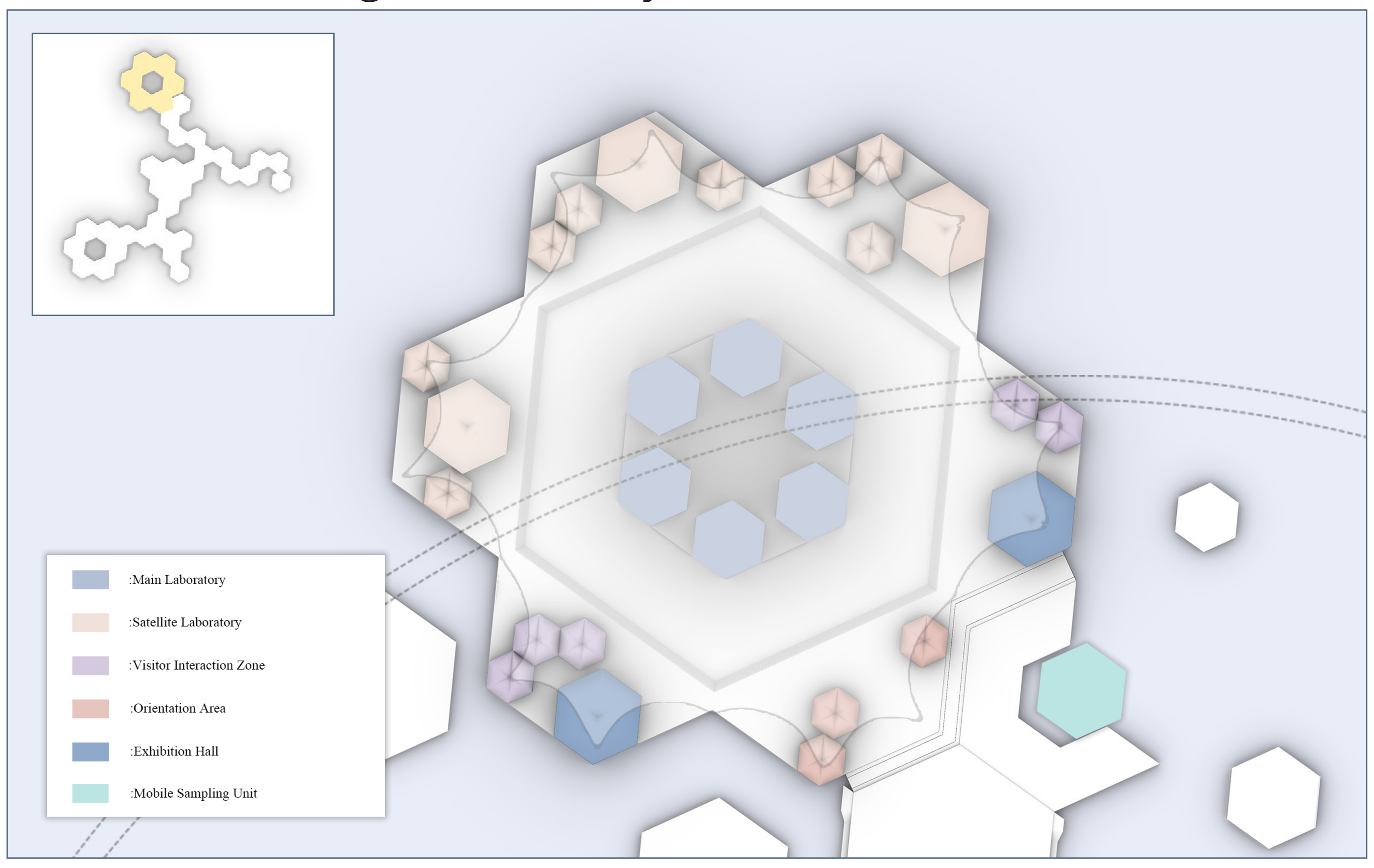
Amenities



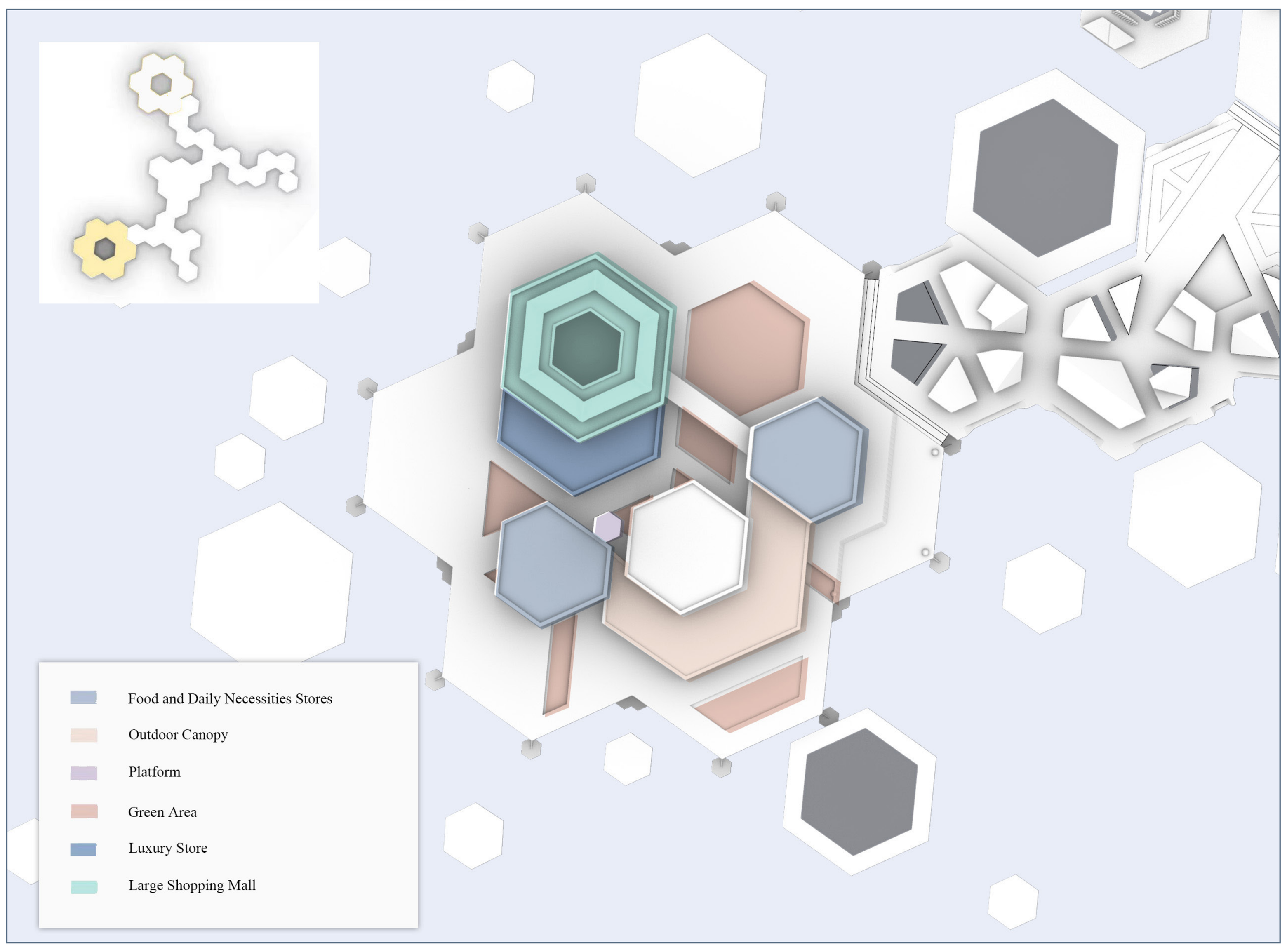


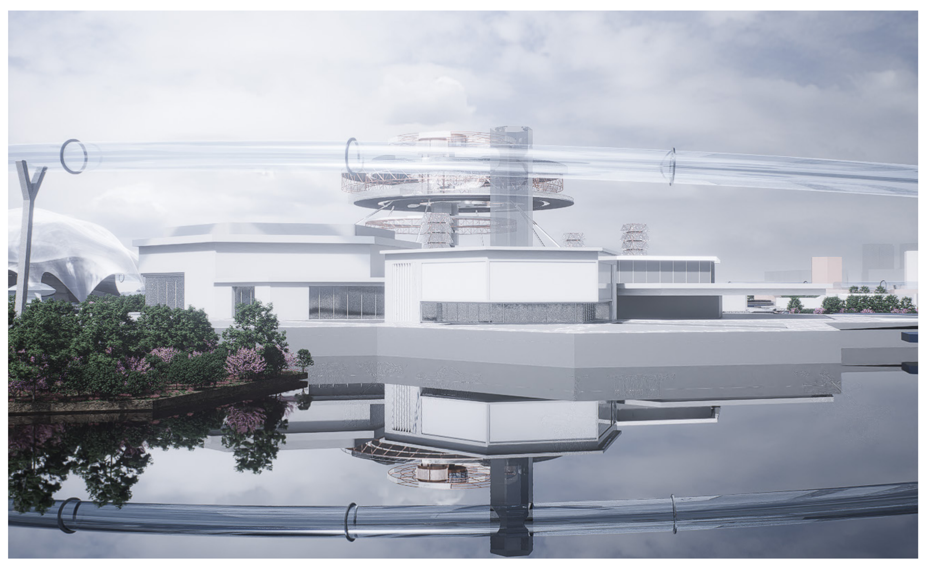


Marine Ecological Labortory



Commercial Center

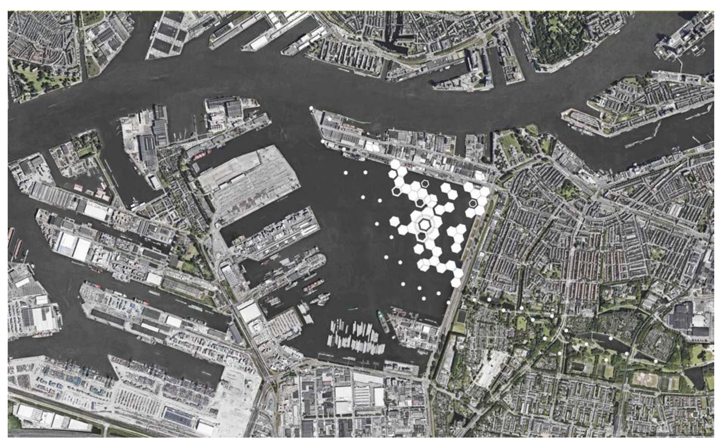




Duplication scenario 1: Singapore

The modular AI Hub floating archipelago is highly replicable in Singapore's East Coast Long Island reclamation project, a massive 800-hectare coastal defense and land creation initiative designed to combat sea-level rise while providing new residential, recreational, and water resilience spaces. Similar to Tung Chung's high-density, land-scarce satellite town setting, the scheme can be directly transplanted as a flexible offshore extension. The core AI Hub island, supported by sea-water natural cooling and solar/tidal energy, addresses Singapore's acute land constraints and public service shortages. Modular floating units with ring-shaped elevated transit and autonomous vessel berthing can integrate seamlessly with Long Island's coastal parks and new reservoir, injecting daytime vitality and smart governance. The design's emphasis on ecological monitoring aligns perfectly with Singapore's biodiversity goals, transforming the area into a resilient, AI-powered blue urban nexus by 2050.

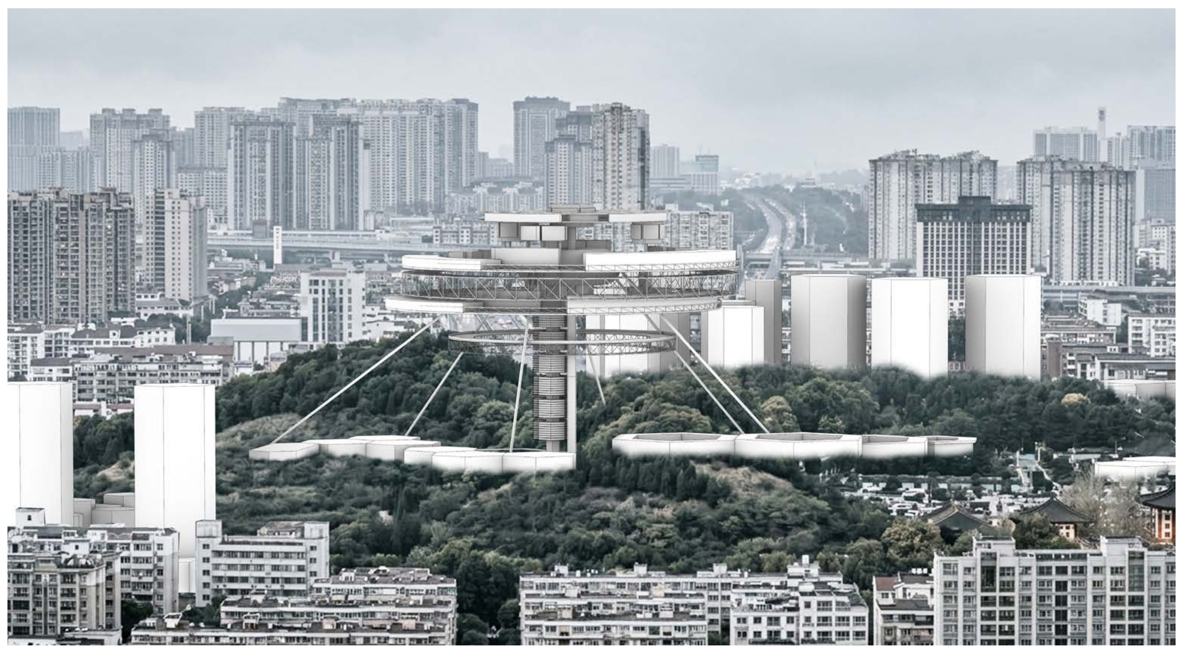
Duplication scenario 2: Rotterdam

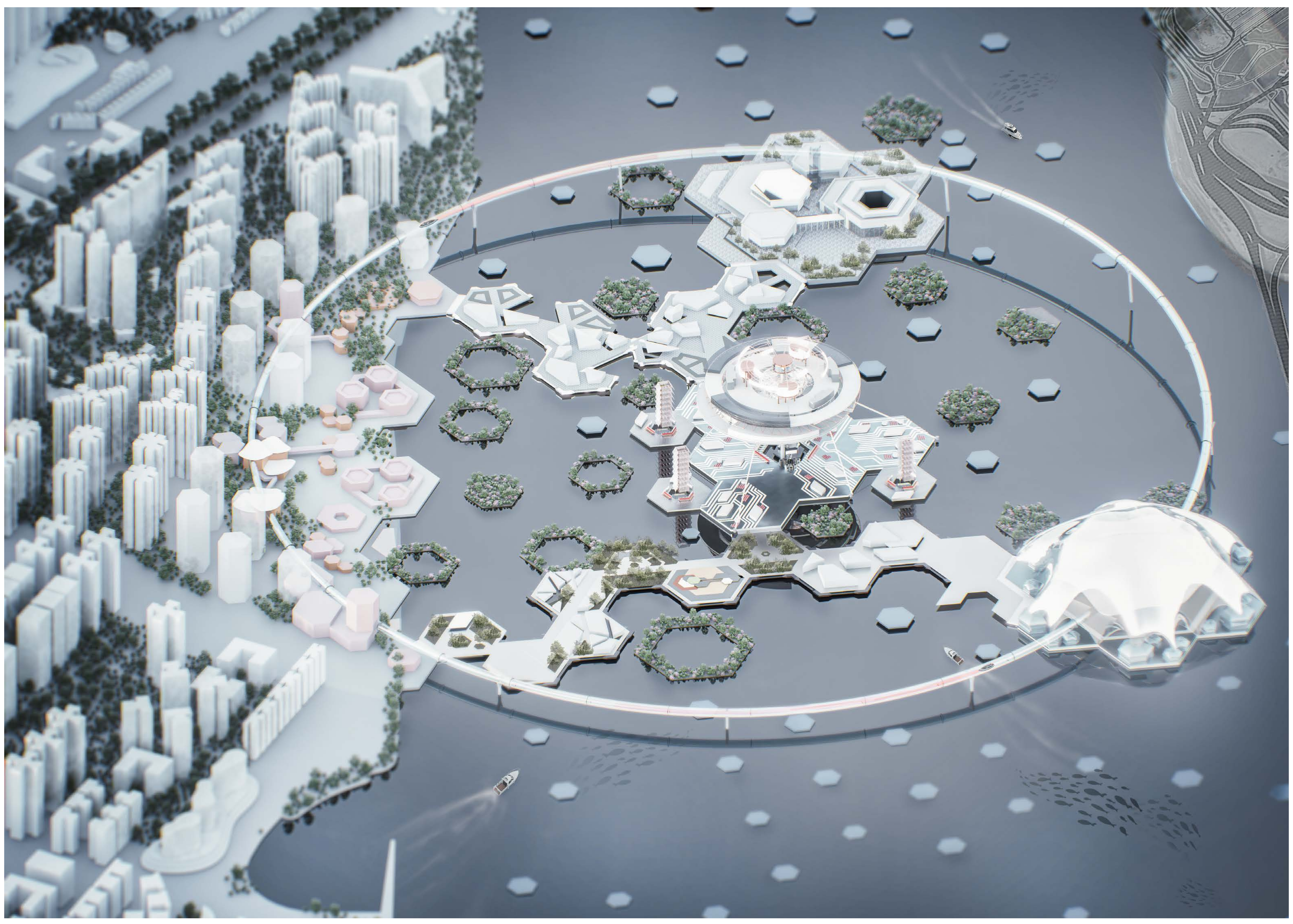


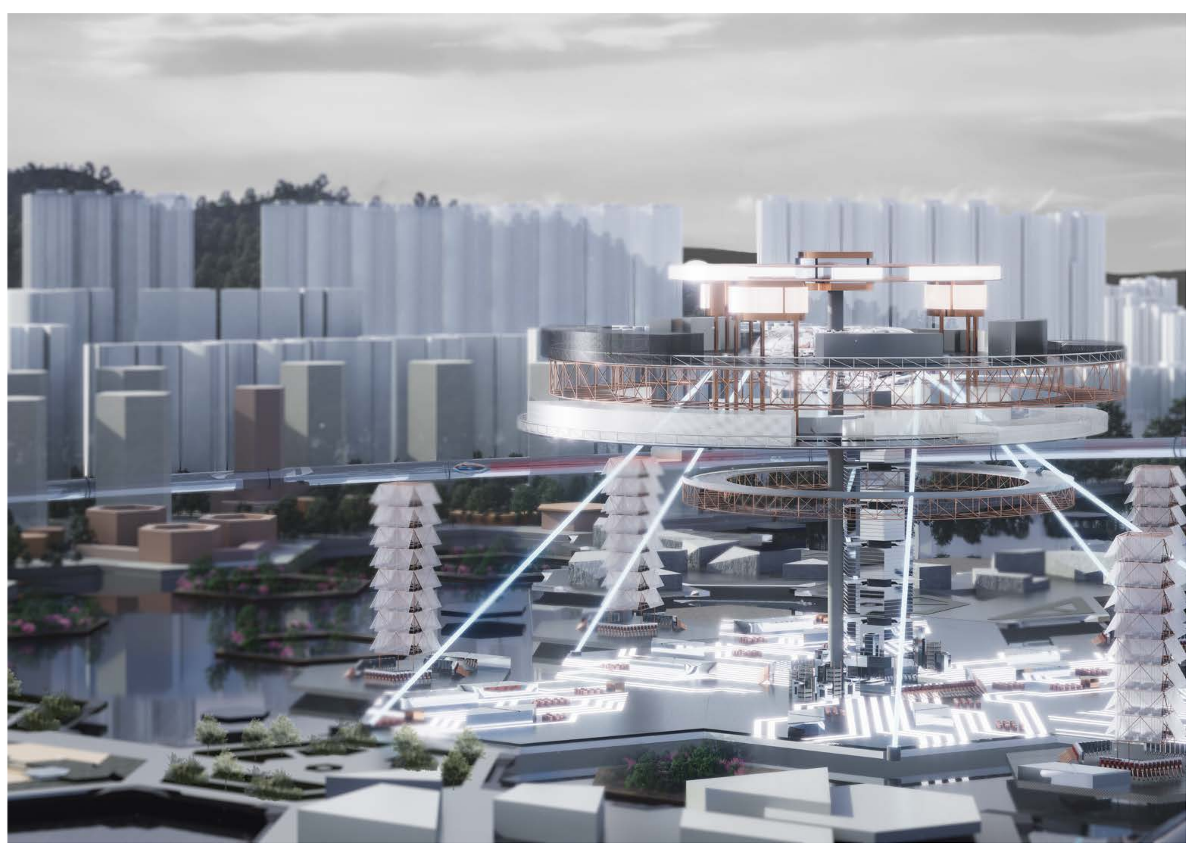
In Rotterdam's Maasvlakte port extension, a major offshore wind hub in the North Sea, the scheme adapts by shifting energy focus from solar-dominant to wind-power integration, leveraging the region's abundant offshore wind resources. The modular floating AI archipelago serves as an intelligent marine extension to the port's industrial and energy infrastructure. The central AI Hub processes local logistics, autonomous shipping, and environmental data, while wind turbines replace many solar panels on dedicated energy islands. The circular elevated ring transit and free-berthing autonomous vessels enhance connectivity between port facilities and new floating public/eco-research modules. This adaptation maintains the core benefits of sea-water cooling and minimal land use, while supporting Rotterdam's energy transition and climate resilience ambitions. By 2050, the system evolves the Maasvlakte into a smart, multi-functional oceanic AI-energy cluster with enhanced ecological value.

Duplication scenario 3: Gui'an New Area

In China's Gui'an New Area, a national-level inland development zone renowned for its concentration of hyperscale data centers and strong computing power base (reaching over 90 EFLOPS with abundant hydropower), the scheme transforms into a land-based modular AI infrastructure cluster. With ample land availability and stable electricity supply, floating energy modules are replaced by ground-mounted renewable stations and advanced terrestrial cooling systems (e.g., geothermal or evaporative). The modular AI Hub retains its central role in local traffic optimization, ecological monitoring, and public services, connected via an elevated ring transit system. Autonomous shuttles and community-governed DAO mechanisms ensure inclusive vitality, addressing the region's need for balanced urban functions beyond pure data processing. This inland adaptation demonstrates the scheme's flexibility, turning Gui'an into a sustainable, distributed AI public utility model that supports China's "East Data West Computing" strategy while enhancing livability by 2050.







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