

IFLA AAPME AWARD 2024
CATEGORIES - ANALYSIS AND PLANNING
(UNBUILT CATEGORY)

PROJECT BINDER
HENGQIN “ZERO CARBON” SEWAGE TREATMENT PARK
Guangdong-Macao In-Depth Cooperation Zone, China

Project Name : Hengqin "Zero Carbon" Sewage Treatment Park, Guangdong-Macao In-Depth Cooperation Zone, China

Project Location : Hengqin Town, Xiangzhou District, Zhuhai City, Guangdong Province, China

Area (sq.m) : 162400 m²

Year of Completion : 2023 (Unbuilt Project)

Award category : Analysis and Planning

PROJECT STATEMENT

This project stands out for its innovative approach to build municipal infrastructure, serving as a model for sustainable environmental protection and urban development. It establishes a new standard for eco-friendly infrastructure by seamlessly integrating energy-saving measures, emission reduction, ecological restoration, and local culture into the treatment plant design. The project adopted a performance evaluation approach to quantitatively analyze and optimize the solution in terms of the purification performance of the artificial wetland and the contribution of carbon sinks, and ultimately find a solution that meets the objectives.

The project's overarching ambition is to transform a high carbon emitting sewage treatment plant into an open and shared "Innovative Eco-friendly Exhibition Hall" through three innovative design strategies and to achieve carbon neutrality by 2060. Through the three integrated strategies of Whole-process Water Purification, Emission Reduction & Carbon Sequestration, and Compound Land Use, the functions of sewage treatment plants are not limited to sewage treatment, thus maximizing environmental, economic and social benefits. The project not only sets a benchmark for future ecologically and economically win-winning municipal infrastructure projects and contributes to the well-being of the community, but also demonstrates its foresight and environmental awareness by aligning with global carbon neutrality targets.

PROJECT NARRATIVE AND CONTENTS

01 PROJECT OVERVIEW

This sewage treatment plant design acknowledges energy-intensive nature of such facilities, typically contributing 1-2% of total carbon emissions. However, it proactively integrates a suite energy-saving measures, emission reduction strategies, ecological restoration initiatives, climate adaptation efforts, and local culture elements. Involving multidisciplinary experts, this project prioritizes energy efficiency, ecological protection, optimized space uses, and cost-effectiveness. The ultimate vision is to transform the site into a "Zero Carbon Park" with no sewage discharge by 2060, aligning with global carbon neutrality targets.

PROJECT OVERVIEW



Logistics
Parking
Area

Rooftop Boardwalk

Second Floor
Restaurant

Technical
Exhibition
Hall

Rooftop Submerged
Wetland

Landscape Corridor Bridge from Erjingwan
National Wetland Park

Fitness
Area

Surface Flow
Wetland
Popularisation
Area

The
Regulating
Pond and
Near-water
Platform Area

Building
Entrance
Hall

Carbon
Capture and
Storage (CCS)
Technology
Popularisation
Area

Sludge Treatment
Popularisation Area

PROJECT NARRATIVE AND CONTENTS

02 BACKGROUND

The project site is in the western coastal gateway of the Guangdong-Macao In-Depth Cooperation Zone, located in Hengqin, Xiangzhou District, Zhuhai City, Guangdong Province, near Macao. Covering 162400 square meters, this area has experienced rapid development since 2009, becoming a vital economic engine for Zhuhai. Currently, sewage generated within the Hengqin New Area is treated at the southern district's sewage treatment plant, handling 40,000 cubic meters daily.

BACKGROUND

- +Hengqin will become an important hub city for economic and trade cooperation between the Mainland, Hong Kong and Macao in the future, thus the demand for warehousing and logistics functions will increase.
- +The project is located at an important node on the Qin-Macao service axis, and should not be limited to a single development direction in terms of space and function.
- +The project is surrounded by important industrial clusters on Hengqin Island.



Therefore, on the basis of meeting the urban service function of the sewage treatment plant, this project takes “logistics” as the theme, utilizes the location relationship between Hengqin and Macao and the economic foundation, and forms a commercial center with certain logistics relief function based on the leading of large-scale warehousing and supermarkets and logistics industry.

PROJECT NARRATIVE AND CONTENTS

03 CONTEXT INVESTIGATION

As development in Hengqin has progressed, sewage production has surged, surpassing the the existing southern district plant's capacity. Long-distance sewage transfer poses safety risks, underscoring the pressing need for the Hengqin Sewage Treatment Plant. It aims to address current and future urban sewage treatment requirements and improve water quality.

With a planned capacity of 400,000 cubic meters per day, the plant will serve the entire island. Preserving the Erjingwan National Wetland Park, Hengqin's largest natural wetland, is crucial. It houses the Near Threatened Eurasian otter, indicating a robust river ecosystem. To protect this ecosystem, the treatment plant must incorporate measures to provide stable and reliable ecological water replenishment for the water shortage faced by the wetland, on top of meeting the water quality requirements needed by the wetland.

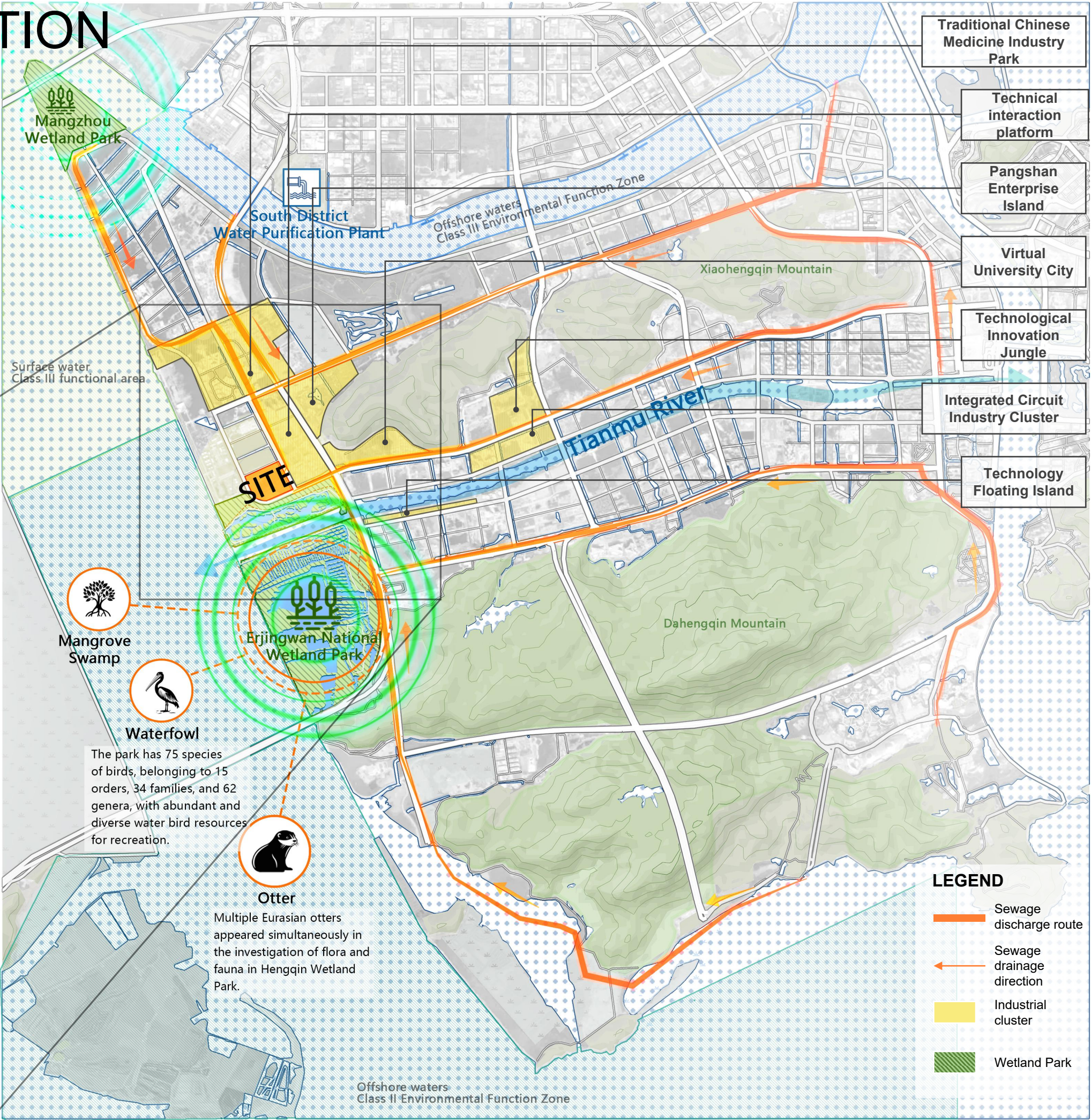
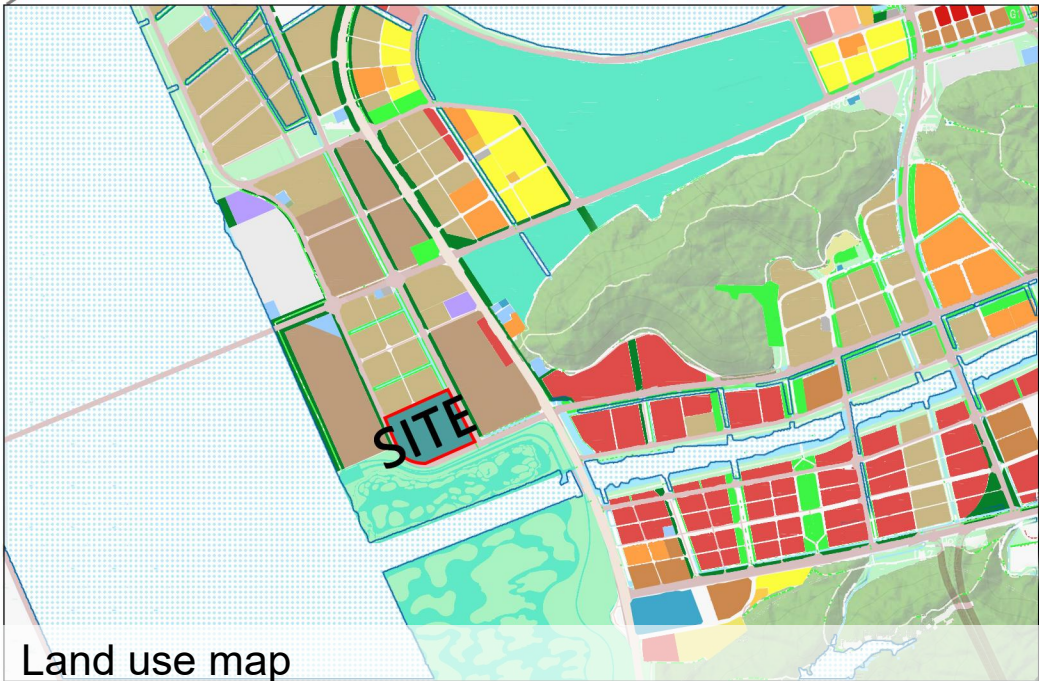
CONTEXT INVESTIGATION

With the development and construction of Hengqin New Area, the original Nanwan Sewage Treatment Plant is already at full capacity and unable to meet the treatment needs.

Disaster risk: Erjingwan National Wetland Park on the south side of the project is an important biological habitat that requires a large amount of water and high water quality, and the lack of water faced by the park is a serious threat to otters, waterfowl, and mangroves.

Climate change: Lack of rainwater storage facilities may lead to flooding disasters.

Conflict: Urban construction land is scarce, and the sewage treatment plant occupy a large area but have low economic benefits. Surrounding industrial parks gather, but lack leisure spaces open to citizens and employees.



PROJECT NARRATIVE AND CONTENTS

04 DESIGN PURPOSE AND STRATEGIES

The design seeks to establish a sewage treatment facility fulfills the current and future requirements of Hengqin New Area. Rooted in principles of sustainability, the design prioritizes environmental protection, energy conservation, and social benefits. Key strategies encompass comprehensive water purification processes, emission reduction and carbon sequestration initiatives, and land use optimization. Furthermore, the project envisions the creation of a pioneering eco-friendly exhibition hall, serving as a testament to its innovative approach and commitment to environmental stewardship.

DESIGN PURPOSE AND STRATEGIES

■ PROBLEMS

- 1. Lack of fresh water resources and urgent need to improve the quality of the water coming out of the sewage treatment plant.
- 2. Tight urban land use and lack of open space for public recreation.
- 3. High runoff coefficient and lack of storage facilities contribute to the potential for flooding.
- 4. The high carbon emission sewage treatment plant is inconsistent with Hengqin's low-carbon development goals.

■ PURPOSE

Building the **Hengqin Ecological Resource Center**.
Creating an internationally oriented Greater Bay Area **Innovative Eco-friendly Exhibition Hall**.

■ STRATEGIES

1. Whole-process Water Purification

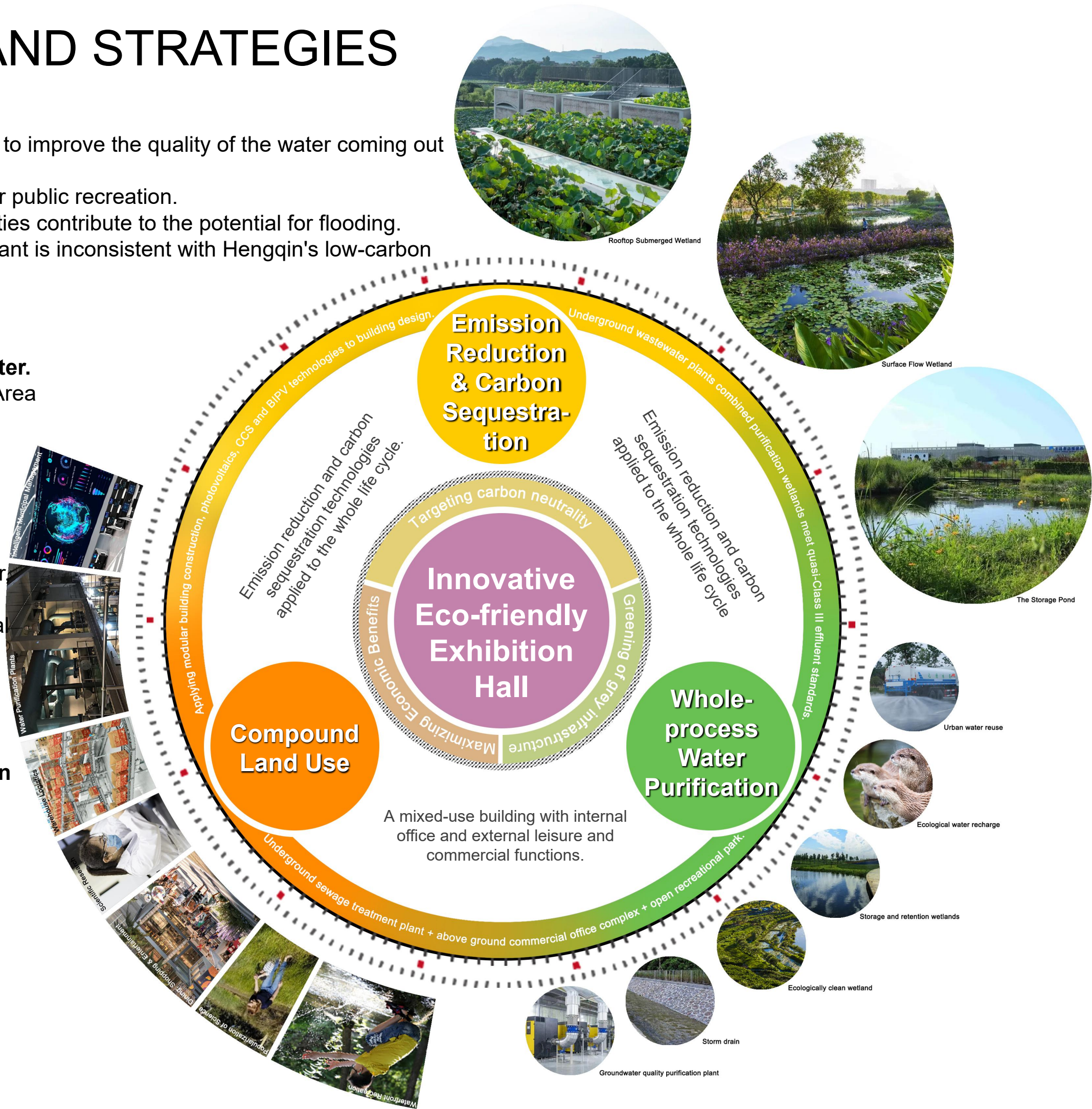
Utilizing ecological and landscaping methods, the site realizes the purification and reuse of tail water so as to achieve the purpose of water reuse and replenishment of fresh water to Erjingwan National Wetland Park. It also integrates the site with the surrounding wetland environment to provide ecological recreational experience and science education.

2. Emission Reduction & Carbon Sequestration

Coupling sewage treatment with energy supply demand in the context of climate change. In the process of full recycling of resources, it realizes the carbon pollution cycle and source reduction, and achieves a win-win situation in terms of environmental and economic benefits.

3. Compound Land Use

The underground sewage treatment plant and multiple functional groups on the ground together achieve the purpose of efficient compound utilization of land resources.



PROJECT NARRATIVE AND CONTENTS

05 DESIGN STRATEGY 1: WHOLE-PROCESS WATER PURIFICATION

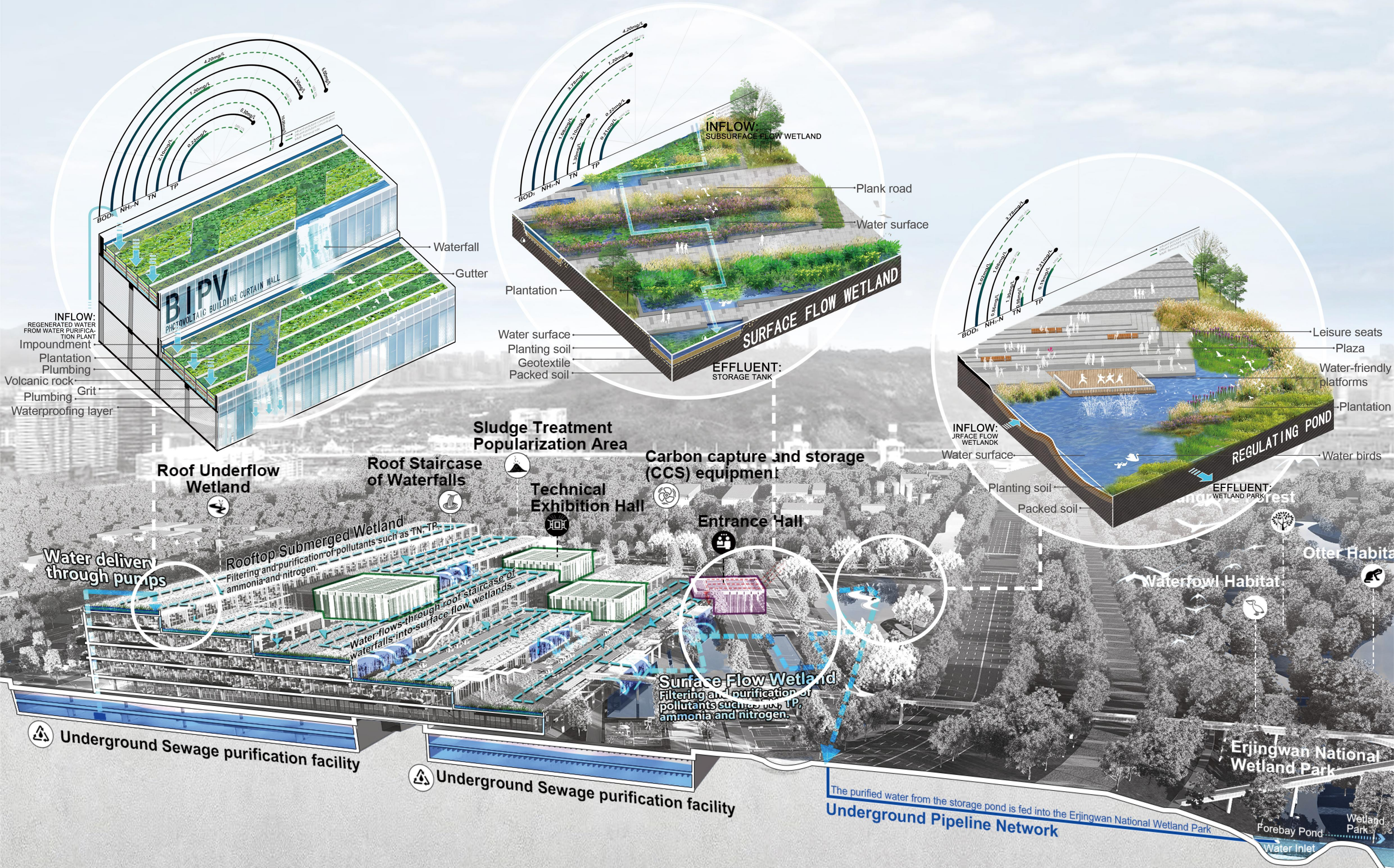
This project addresses freshwater scarcity and improves effluent quality through a composite flow artificial wetland system merging gray and green infrastructure. Treating 7,500 cubic meters daily, the system employs technologies like multi-component composite flow wetlands, wetland network aeration, and new fountain aeration devices.

Purified tailwater, is pumped to subsurface flow wetlands atop rooftops, cascading over five levels across 18,000 square meters, creating aeration waterfalls. Indigenous aquatic flora assist in filtration. The surface flow wetland, spanning 11,500 square meters at south, incorporates fountain aeration at inlet and outlet points. The system fosters a water cycle through evaporation, infiltration, plant transpiration, and water recycling for replenishment and irrigation.

Erjingwan National Wetland Park receives treated water for ecological supplementation, with excess used for landscaping, recreation, and Macao enterprises supply. Effluent meets international water quality benchmarks, reducing COD, TN, and TP removal rates of 70%-80%, 80%-90%, and 70%-80% respectively. Annually, the system purifies 2.7 million cubic meters of water, eliminating 297.75 tons of COD, 36.08 tons of TN, and 2.31 tons of TP, at a cost of 0.05-0.08 RMB per cubic meter.

Integrating municipal flood drainage channels into the wetland ensures "zero discharge" of rainwater, alleviating urban flood control pressure. This approach maximizes resource efficiency, enhances ecological and functional benefits, and improves the overall environmental quality of the New Area.

STRATEGY 1: WHOLE-PROCESS WATER PURIFICATION



PROJECT NARRATIVE AND CONTENTS

06 DESIGN STRATEGY 2: EMISSION REDUCTION & CARBON SEQUESTRATION

The project synergizes underground sewage treatment, green building technologies, and innovative carbon sequestration for carbon neutrality, thus improving environmental quality and sustainability. Emphasizing "carbon neutrality" throughout its lifecycle, it meticulously integrates "emission reduction" and "carbon sequestration" strategies.

For "emission reduction", it targets nitrous oxide, methane, and indirect emissions. An advanced "AAO biological tank + secondary sedimentation tank" process excels in nitrogen removal and minimizes energy and chemical consumption. High-performance sedimentation tanks, UV light, and sodium hypochlorite disinfection further curtail energy use, alongside the biogas power generation within the sludge treatment sector.

Above ground, Building Integrated Photovoltaics (BIPV) technology generates 2,400,000 kWh annually, from a 12,000 m² photovoltaic roof, thereby offsetting 2,400 tons of CO₂ emissions, satisfying the electricity needs of 1,200 residents.

Regarding "carbon sequestration", the project uses rooftop, ground wetlands and forest grass to absorb CO₂ through photosynthesis. Advanced technology captures and recycles carbon from the air, thus reducing industrial park carbon emissions. This captured CO₂ can substitute petroleum in chemical production, such as methanol synthesis.

Beyond above, the project establishes a comprehensive digital environmental management system for monitoring, supervision, emergency response, operation and maintenance, analysis, and decision support. This system aims for full resources recycling, effectively transforming the park into an ecological energy hub.

STRATEGY 2: EMISSION REDUCTION & CARBON SEQUESTRATION

SUMMARY OF MEASURES FOR EMISSION REDUCTION AND CARBON CAPTURE

Design Phase Measures

- ✓ Energy Cycle Design
- ✓ Designing passive building facilities.
- ✓ Designing naturalistic and easy-to-maintain planted landscapes.
- ✓ Designing rainwater resource collection and utilization systems.
- ✓ Designing water landscapes that function as climate regulators.

Construction Phase Measures

- ✓ Constructed using modularized units.
- ✓ Constructed with low-carbon and environmentally friendly materials.
- ✓ Construction of walls with BIPV (Building Integrated Photovoltaics).
- ✓ Plant selection is as native as possible.

Maintenance Phase Measures

- ✓ Rough plant management practices are used.
- ✓ Adoption of smart garden maintenance techniques.
- ✓ Adoption of water-saving irrigation techniques.
- ✓ Increase biodynamic maintenance and reduce the use of machinery.
- ✓ Use of organic fertilizers and environmentally friendly conservation practices.
- ✓ Recycling Human Fertilizer.

CLIMATE POSITIVE DESIGN - CARBON CALCULATION OVER 50 YEARS

Plants

Moderate management lawn	2,159.4 kg
Perennial grasses perennials	170,473.4 kg
Deciduous small shrubs	1,269,837 kg
Deciduous medium shrubs	20,166,786.1 kg
Evergreen small shrubs	225,634 kg
Evergreen medium shrubs	507,690 kg
Evergreen large shrubs	150,450 kg
Deciduous medium trees	428,245 kg
Deciduous large trees	168,850 kg
Evergreen large trees	369,930 kg
Evergreen medium trees	362,432 kg
Evergreen small trees	10,152 kg
Deciduous small trees	151,166 kg
Wetlands	6,792,729.8 kg

Subtotal
12,034,017 kg

Calculated data sources:
<https://app.climatepositivedesign.com>.

Materials

Asph alt - Vehicular	212,915.3 kg
Stone Paving	1,626,548.9 kg
Rubberized Play Surfacing	279,400 kg
Steel Trellis / Built in Feature	20,166,786.1 kg

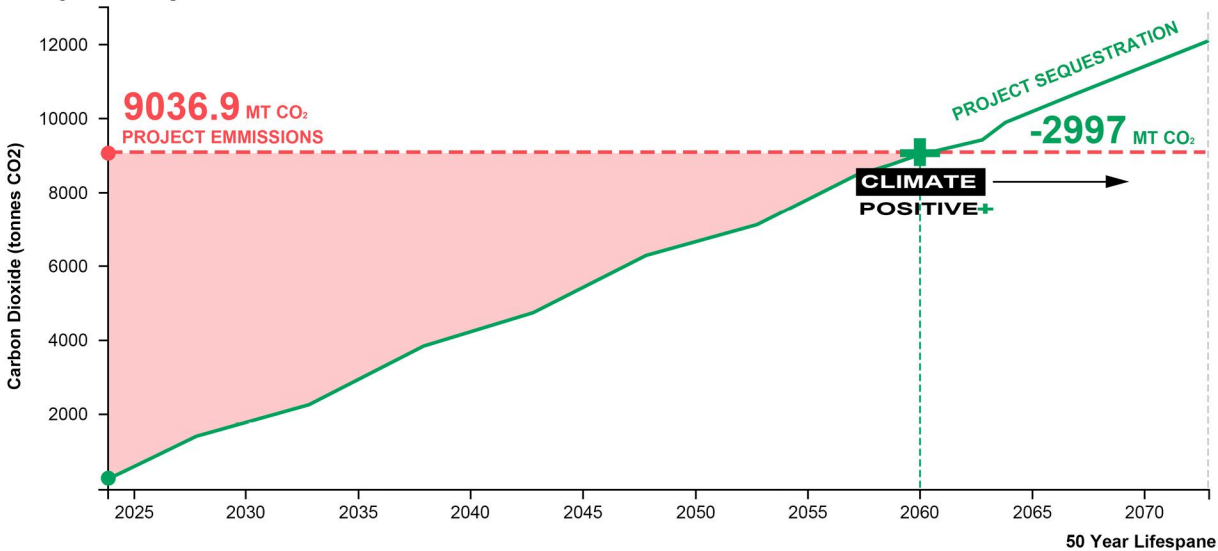
Subtotal
22,285,650 kg

Operations

MIC -Prefabricated building	10,130,400 kg
Lawn-mowers	741.9 kg
Solar Power - BIPV	3,121,480 kg
Leaf blowers/Vacuums	2,419.1 kg

Subtotal
13,248,719 kg

Project Impact



This project is expected to reach **climate positive in 37 years**, in 2060.

This project will sequester **2997 tons** more carbon than it emits in its estimated lifespan.

The value of the sequestration is estimated to be **416,720 RMB**.

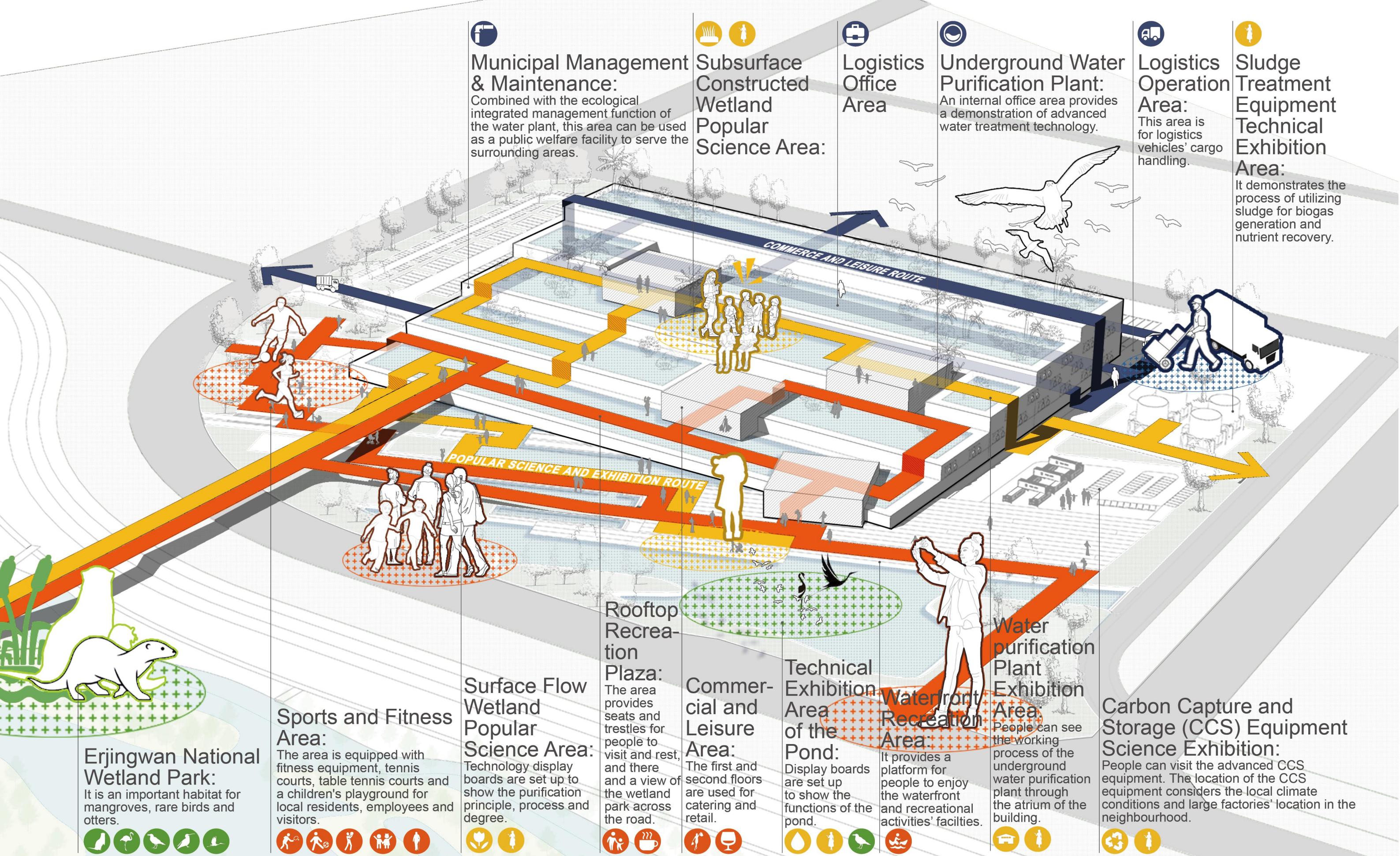
PROJECT NARRATIVE AND CONTENTS

07 DESIGN STRATEGY 3: COMPOUND LAND USE

Through the Compound Land Use strategy, the project spatially forms three routes for different activity groups, providing an open and shared activity space for all-age corporate employees, neighboring residents and foreign tourists to maximize land use.

In addition to the underground sewage plant's function of treating 400,000 cubic meters of urban domestic sewage per day and supplying water to the wetland, the 70,000 square meter "Hong Kong – Macao New Energy Building Technology Industrial Park" above ground provides catering and retailing, municipal management and maintenance, warehousing and logistics offices, scientific research and science exhibitions, and in addition to that the project provides recreational space through a 25,000 square meter open area and 160 public parking spaces to mitigate the "not in my backyard" (NIMBY) effect.

STRATEGY 3: COMPOUND LAND USE



PROJECT NARRATIVE AND CONTENTS

08 OVERALL EFFECT

This project’s comprehensive approach integrates water treatment, emission reduction, land use, and community benefits to model sustainable urban development and ecological restoration. By addressing environmental, social, and economic factors, it aims to improve water quality, reduce carbon emissions, and enhance urban resilience and community well-being.

OVERALL EFFECT



PROJECT NARRATIVE AND CONTENTS

09 LANDSCAPE PERFORMANCE SERIES: ENVIRONMENTAL BENEFITS


The project yields environmental benefits by reducing pollution, improve water quality, conserving natural resources, and boosting biodiversity. Native plants and ecological restoration techniques foster a healthy ecosystem, while advanced water purification technologies ensure effluent meets high standards. Furthermore, the project curbs carbon emissions and the promotes sustainability.

LANDSCAPE PERFORMANCE SERIES: ENVIRONMENTAL BENEFITS

 **50,000** m² composite purification wetland
will achieve the removal rate of nearly **80%**
of annual runoff pollutants

 **90%** of the total annual runoff control rate will
be achieved by constructing storage landscape
wetlands and infiltration and storage ponds

 Underground sewage treatment plant
will have a capacity of
400,000 m³ per day

 Hengqin "Zero Carbon" Sewage Treatment
Park will provide **10,000** m³ Class III
water standard ecological water replenishment
for downstream wetland park every day

PROJECT NARRATIVE AND CONTENTS

10 LANDSCAPE PERFORMANCE SERIES: SOCIAL BENEFITS

The project's social benefits encompass creating open spaces for children's entertainment, recreation and fitness, and science education, which enhance public health and well-being and embody the concept of social equity, in addition to raising public awareness of sustainable development practices. Green infrastructure and community facilities encourage social interaction, while the zero-carbon exhibition hall and educational programs raise environmental conservation and sustainable development awareness.

LANDSCAPE PERFORMANCE SERIES: SOCIAL BENEFITS



50,000 m² urban complex construction area, including 96,890 m² logistics warehousing, 28,100 m² commercial service, 20,000 m² technical exhibition hall, 7,800 m² municipal management offices.



55,000 m² urban open space with hydrophilic surface.



575 public parking area, **165** logistics parking area.



PROJECT NARRATIVE AND CONTENTS

11 LANDSCAPE PERFORMANCE SERIES: CARBON EMISSION REDUCTION AND TECHNOLOGY SCIENCE POPULARIZATION EXHIBITION

The project notably reduces carbon emissions via advanced technologies and sustainable practices including photovoltaic panels, biogas power, and carbon capture. These showcases the potential for shrinking urban carbon footprints. The zero-carbon exhibition hall informs the public and stakeholders about the benefits and feasibility of carbon-neutral practices.

LANDSCAPE PERFORMANCE SERIES: CARBON EMISSION REDUCTION AND TECHNOLOGY SCIENCE POPULARIZATION EXHIBITION



Reducing 1500 tonnes per year through photovoltaic power generation, it reduces Carbon dioxide emissions by .



Reduces on-site labor by **70%** and solid waste emissions by **75%**, showing the advantages of high efficiency, high quality, green and low carbon, material and labor saving.



Reduces Carbon dioxide emissions by **1200** tonnes per year by generating electricity from biogas.



Recover **16,000** tonnes of fertilizer through nutrient recycling and conversion, valued at about **60 million RMB**.

PROJECT NARRATIVE AND CONTENTS

12 CONCLUSION

This project promotes sustainable development via multidisciplinary expertise and ecological strategies, enhancing sewage treatment, resource usage, park-community integration, and restoration. By emphasizing collaboration, it balances social, ecological, technological, and climatic needs, serving as a restoration and adaptation model. Continuous integration improves plant operation and public spaces, aiming to create a sharing, innovating and integrating landmark for Hengqin New Town, which is in the midst of historical development, showcasing sustainable practices.

SHARING



"Zero Carbon" Sewage Treatment Park Entrance



Rooftop Submerged Wetland with Boardwalk

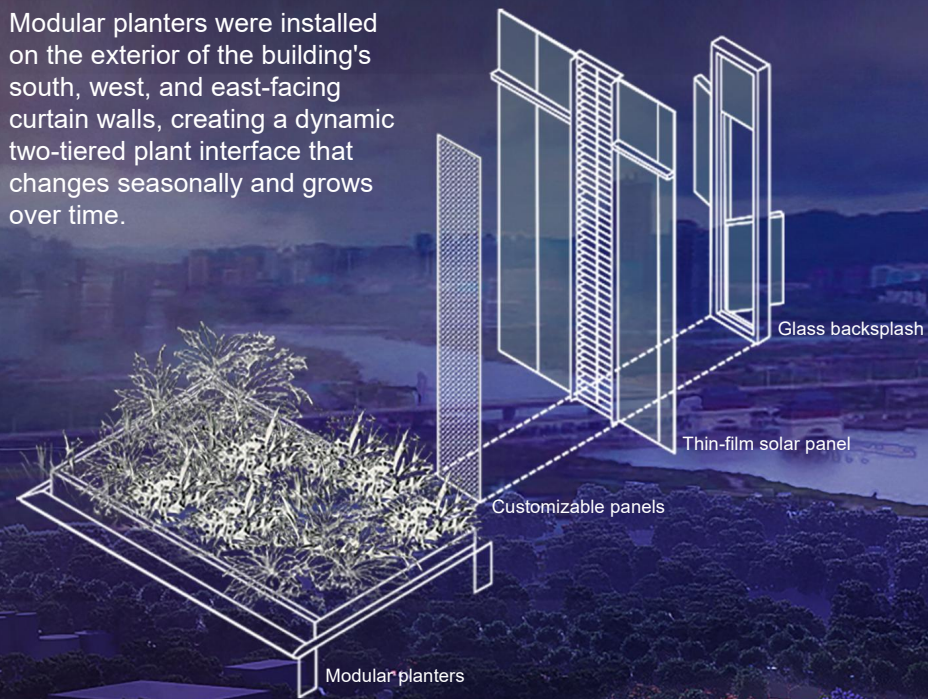


Recreation Area

"Zero Carbon" Sewage Treatment Park Nightscape Bird View

Facade Embedded Structure

Modular planters were installed on the exterior of the building's south, west, and east-facing curtain walls, creating a dynamic two-tiered plant interface that changes seasonally and grows over time.



INNOVATING

Landscape bridge connecting Erjingwan National Wetland Park and "Zero Carbon" Sewage Treatment Park



INTEGRATING