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# Project Report on the Five Years Construction of the First Low-Carbon Town - Yujiapu CBD

## APEC Energy Working Group

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# Part 1

# Yujiapu Low Carbon Development

# 1 Overview for Yujiapu Low Carbon Model Town

## 1.1 Introduction of Yujiapu

### 1.1.1 Geographical Location

Yujiapu Financial District is located in the core area of Central Business District of Binhai New Area. It is 170km away from Beijing and 45km away from the downtown city. Adjacent to Binhai International Airport, Tianjin Port and it is 45 minutes from Beijing to Yujiapu Financial District by the Intercity High Speed Rail.

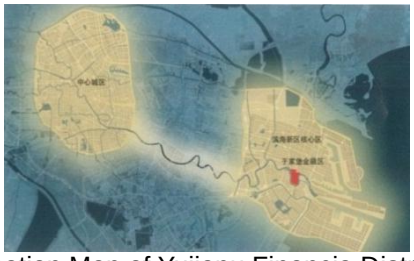

Figure 1.1.1 Location Map of Yujiapu Financia District

### 1.1.2 Regional Characteristics

Yujiapu Financial District is located on the north bank of the Haihe River downstream and surrounded by water on the east, west and south. As a completely new urban area, it lacks all aspects of infrastructure. The relocation of the peninsula is huge and the infrastructure investment is also very large. Due to the peninsula surrounded by the Haihe River, flood control and flood prevention issues, the problems of foreign traffic have further increased the scale of construction investment. Therefore, in the planning and construction, we must focus on its special geographical location and ecological background and so on.

(1) Limited land space, high density and high energy consumption in cities. Limited land space means high density of urban space. Due to the high energy consumption per unit area in high-rise buildings, which is the main source of urban heat pollution(heat island effect), it is difficult to use low-energy-density renewable energy and it's difficult to utilize passive energy-saving measures in super high-rise building.

(2) Surrounded by water, traffic pressure heavy, energy supply inconvenience. Yujiapu is a peninsula surrounded by Haihe River on the east, west and south. The bridges is the connection with outside. However, the excessive bridge construction will destroy the natural landscape of Haihe River and the image of the riverfront city in Yujiapu. Also because of the geographical form of the peninsula is not conducive to the links of municipal pipelines, resulting in inconvenience in energy supply.

Figure 1.1.2 Satellite Aerial View of Yujiapu Financial District

(3) Resources and energy are scarce, carbon emission is high. From the perspective of energy density, land use and cost, the usage of solar power and wind energy has little practical effect on carbon emission reduction compared with CBD or urban downtown area. Cities

increase their carbon sequestration by green roofs and vertical afforestation, which can reduce their carbon emissions to a certain extent. However, due to the high carbon emission density in urban centers, the contribution of simply increasing carbon sinks to carbon reduction is relatively low compared to other approaches.

(4) Ecological deficit, ecological carrying capacity is too excessive. In 3.43 square kilometers of the CBD to accommodate 300,000 working life population, high-intensity land development will bring great pressure on the natural ecological carrying capacity.

## 1.2 Master Plan of Yujiapu

### 1.2.1 Planning Concept

The planning of Yujiapu Financial District: surrounded by Haihe River to the east, west and south, to the north is Xingang Road, Xingang 3rd Road. The width of east-west is 1.2km; length of north-south is about 2.8km, with a total planned area of 4.12 square kilometers. The planned land area for construction is 3.43 square kilometers, with a total construction area of 9.03 million square meters, the planned working population of Yujiapu is 300,000 and permanent living population is 68,000.

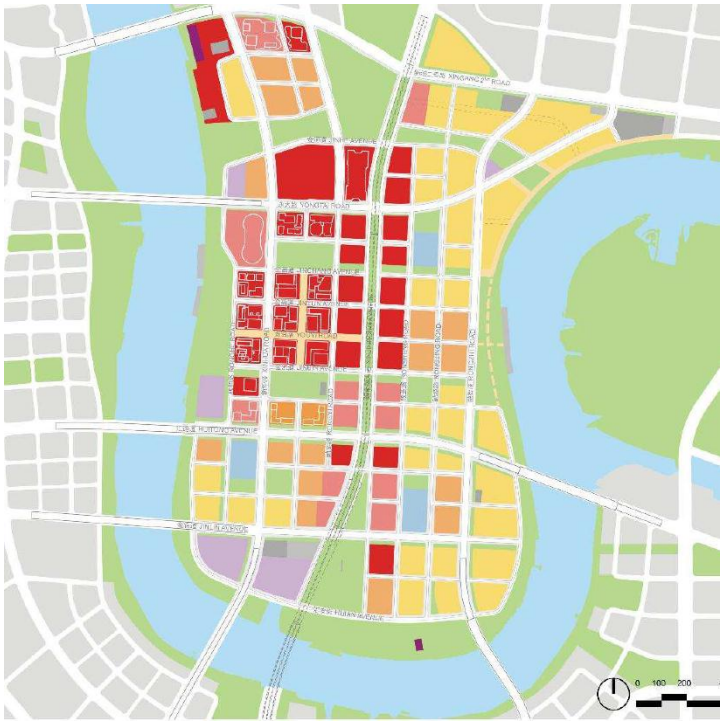

Figure 1.21 Master Plan of Yujiapu Financial District

In Yujiapu Financial District, the strength of land development and the volume ratio of each plot are high; the floor area ratio of the core area is extremely high. The planning uses the spatial forms of high-rise buildings, super high-rise buildings, small plot and dense road-network. The characteristics are as followed:

(1) High-quality public areas: a city centered on the Haihe River, a city that transforms industrial sites and river ports into new healthy living communities.

(2) Transit-oriented development city: a transportation mode that leads in all directions and intermodal transportation. 80% of residents and workers coming to the city will use public transportation, walking or cycling.

(3) Active multi-functional space: rich functional layout, including office, service,

residential, entertainment, culture. The open space surrounding the river, the canal and the park create a comfortable place for working, living and entertaining.

(4) Clear parcel and high-quality buildings: a clear plot layout that accommodates business services as well as banks and a host of other functions. Moderate plot size gives the possibility and flexibility of long-term growth strategy.

### 1.2.2 Functions and Planning

Functions. As the financial reform and innovation base with China's leading, world-class, comprehensive functions and perfect service, Yujiapu Financial District bring together five industrial areas combining exhibitions and conventions, traditional finance, modern finance, education and training, business and commerce, building Yujiapu into the China's leading and world-class financial reform and innovation base offering comprehensive functions and perfect service.

(1) Planning poisoning and development goals

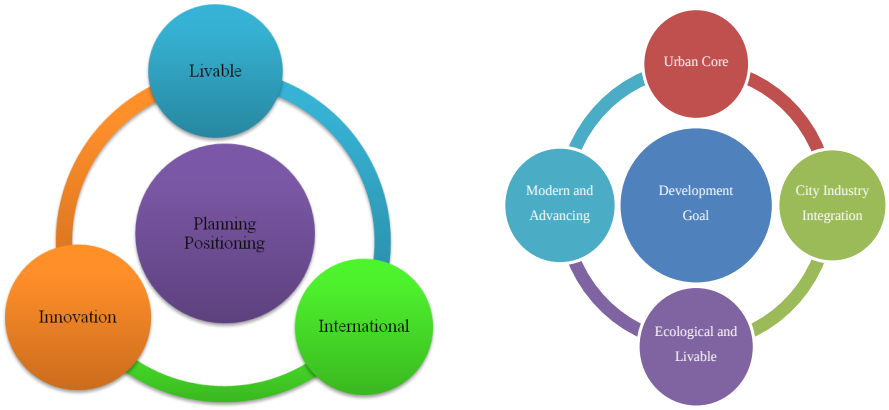


Figure 1.2.2 The Planning Positioning and Development Goals of Yujiapu Financial District

### 1.2.3 The Principle of Planning

According to the positioning and development goals of Yujiapu Financial District, the 8 planning principles were formulated.


Figure 1.2.3 The Planning Principles of Yujiapu Financial District

On this basis, the low-carbon planning principle was tailored to its low-carbon sustainable development.

- Sustainability. Taking the sustainable development as principle, the urban planning of Yujiapu Financial District aims to achieve international standards in terms of resources conservation, user quality of life and environmental protection by setting long-term goals and plays an important role in infrastructure, increasing household satisfaction and greenhouse gas emission reduction.
- Demonstration. Yujiapu Financial District pays attention to the forward-looking and guiding development, and its construction standards are higher than the China regional standards, which can serve as a model and a leading role in building a successful low-carbon model town in APEC to guide the same type of financial district low carbon development.
- Operability. On the premise of economy, we will formulate high-standard indicators from the controllable aspects of energy sources and resource conservation to ensure the final implementation of low-carbon construction. According to the climate characteristics of Tianjin, Yujiapu site conditions and the current implementation of low-carbon technologies, security indicators are indeed reachable.

### 1.2.4 The Features of Planning

(1) The first financial district with rich three-dimensional structure, the underground space in domestic planning. All three underground spaces are connected with the surrounding buildings, to achieve subway, underground business and parking throughout. From mixed use of land to single building function mix, it forms a composite low carbon city from vertical to horizontal.

(2) A financial district based on ecological landscape and friendly to the natural environment. Among the 3.43 million square meters of construction land in Yujiapu Financial District, 1 million square meters are planned as green belts, including the river-bank landscape belt, Central Avenue landscape belt, urban road landscape belt and a couple of parks with a total area above 20,000 square meters.

(3) To adopt new block-style residential building and create a new block-based system which is surrounded by the city main roads, small streets, high density road network, public transport facilities , public services and facilities close to supporting the open neighborhood mode. The biggest advantage is that can make urban life more convenient, traffic cycle more open to share resources and realize harmonious, livable and dynamic new city.

### 1.2.5 The Development Sequence

The development sequence of Yujiapu is divided into 4 stages, which are completed, near term construction, mid-term construction and long-term construction; the development cycle is 15-20 years. Among them, the "9 + 3" 12 plots of starting area have been basically completed and some of the buildings have been put into operation.

Figure 1.2.4 The Construction Division of Yujiapu

# 2 Low Carbon Planning and Construction of Starting Area of Yujiapu Financial District

## 2.1 Overview and Development Goals of Starting Area

(1) Overview of starting area

The starting area of Yujiapu covers an area of 1 square kilometers. This area is planning to build 35 buildings with a total construction area of about 3 million square meters.


Figure 2.1.1 The Scope of Yujiapu Starting Area

The starting area of phase one under construction now includes “9+3” 12 buildings, namely 9 office buildings and 3 supporting buildings of hotels, financial conventions and service centers with a total site area of about 263,000 square meters. The total construction area is 1.76 million square meters, of which the ground floor area is 1.27 million square meters while the underground part of the building area is 490,000 square meters.

Figure 2.1.2 The Scope of 12 Buildings in Starting Area

(2) Development goals

• Laying the foundation of a world-class central business district

• To establish a flexible framework for growth

• To create a high-quality office space, and attract peripheral financial institutions and related services

• To build World-class Convention and Exhibition Center along Haihe River

• A path to connect Riverside Park and Haihe River

• To design and construct the world-class transport hub mingled with the Beijing-Tianjin intercity high speed rail

• To provide guidelines for sustainable design, development and construction

• Creating a suitable street and joyful atmosphere through the streetscape and city park design

• Fully stimulate the imagination of the local residents, and put them into the future construction of Binhai New Area.

(3) Formulation of special plans

Based on the Master Plan, Yujiapu Financial District has deepened the high-level urban design and detailed regulatory plan. Taking this as general control and general direction, combined with the strategy of sustainable development planning and low carbon model town construction in Yujipu Financial District, the special plans were formulated according to local conditions, and low carbon strategy and technology were fully adopted in the special planning process. In the development and construction of the starting area phase one, we must carry out the low-carbon concept strictly according to the special plans in the aspects of building, transportation, energy, underground space and landscape, and constantly explore and innovate in the process of practice. The special planning is listed in Table 2.1.

Table 2.1 Special Planning in Yujiapu Financial District

| | |
|---|---|
| Special Planning | *Special Planning on Yujiapu Green Building* |
| | *Integrated Transportation Planning of Yujiapu* |
| | *Low Carbon Energy Planning of Yujiapu* |
| | *Underground Space Planning of Yujiapu* |
| | *Pipeline Coordination Planning of Yujiapu* |
| | *Special Planning on Yujiapu Landscape* |
| | *Special Planning on Yujiapu Public Service* |
| | *Smart City Planning of Yujiapu* |

(4) Construction and implementation

In 2009, the detailed regulatory plan of Yujiapu was approved by the governments at both city and district level and the construction of Yujiapu High Speed Railway Station and “9+3” plots in starting areas were started right after.

Figure 2.1.3 Yujiapu Financial District is poised for construction in 2009

Figure 2.1.4 Starting Area of Yujiapu under Construction in 2013

After more than five years' construction, the first phase of starting area has taken shape and gradually put into operation. In particular, it has carried out and completed low-carbon special plan and researches in the fields of construction, transportation, energy and landscape, and formulated scientific implementation plans by the research results to guide the landing of low-carbon plan in the starting area. Buildings, transportation, energy stations, parks and other infrastructure has been gradually put into operation.

Figure 2.1.5 Nightscape of Yujiapu Starting Area in 2017

## 2.2 Green Building

In the development and construction of Yujiapu Financial District, we insisted on the principle of planning first. The green and energy-efficient buildings were vigorously promoted, strictly enforced mandatory standards for energy-saving of new buildings and a system for appraising energy use rationally, and used green energy-saving design methods and construction technologies to promote new green building energy-saving construction, to achieve the proportion of green buildings reached 100%, and the high star green buildings are more than 70% .

### 2.2.1 Technical Indicators Strategy

(1) Building setback

The 5 meters of setback helps to create a pleasant street scale, create a street atmosphere and create an urban ambience; increase the efficiency of the site to 80% while increasing the area available for each parcel by 15%; and smaller building setback favor a reasonable flat layout accommodates more green space, courtyard and service space while maintaining a reasonable building layout.

(2) Ratio of green space strategy

Integration of adjacent green land parcels. Integrate the scattered green plots in each parcel into a whole, maximize the use of land parcels, while the overall greening rate and green space visibility increased, and there are more consistent environmental characteristics.

### 2.2.2 Special Planning on Green Building

(1) Planning level

The special planning on Yujiapu green building taking the spatial layout of green building as core, through researching and collecting the basic information in the region, integrated the overall objectives of construction - "low-carbon smart city", it is necessary to select the influence factors of the planning angle, the impact factor of the architectural single angle and the construction of the installment, by using the analytic hierarchy process , the green star potential of the building on each plot is determined, and it is formed in the star layout map of the green building in Yujiapu Financial District.

Figure 2.2.1 Green Building Planning in Yujiapu

The assessment method of green building star layout provides guidance for land transfer and subsequent design and construction of all plots, and provides a solution for large-scale green building promotion.

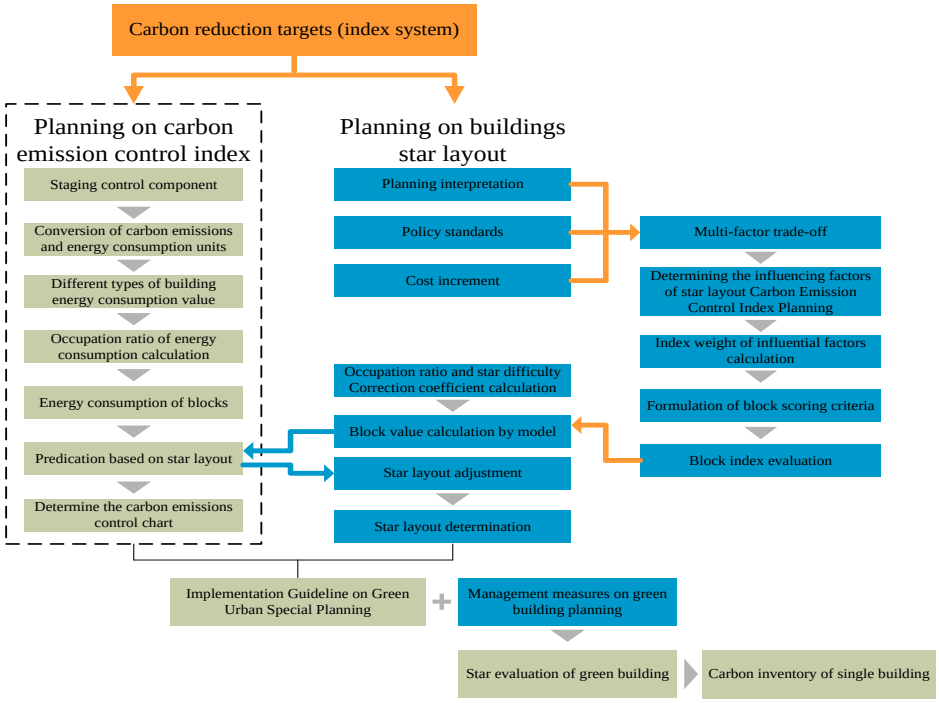


Figure 2.2.2 Building System Framework of Special Planning on Yujiapu Green Building

(2) Building monomer level

A large number of super high-rise buildings are planned to be constructed in Yujiapu Financial District, which is with advantages of intensive, vertical development, image prominent, landmarks etc. but there still exists some disadvantages, as high energy consumption, poor indoor environmental quality, high cost of construction and maintenance. Therefore, super high-rise buildings should focus on the implementation of control and regulation of indoor air quality, thermal comfort, lighting and other environmental elements to optimize the entire process of design and control of selection, usage, maintenance and emission of energy, water resources, building materials. Through the establishment of convenient functional system, intelligent control is implemented to ensure operational safety. In addition, the super high-rise building in Yujiapu mainly adopts the framework of the core tube structure system, the main structural materials used in the construction of high-strength steel, greatly reducing the amount of materials, increasing the use of building area, effectively reduce carbon emissions. At the same time, super high-rise buildings generally have the characteristics of large building area and complicated functions. They have abundant waste water resources and can be effectively reduced to the purpose of saving water by using the reclaimed water technology.

### 2.2.3 The Construction Status of Green Buildings in Starting Area

Yujiapu Financial District aims to build a high-star super high-rise green building with ten-million-scale scale, achieving 100% green building coverage in the area and over 70% high-star green building. At present, while the buildings in 03-06, 03-18, 03-20 plots are one-star green buildings, the rest buildings of “9+3” in starting area are two-star green buildings or above. Meanwhile, in the fine decoration process of a number of plots of fine decoration process, green materials, energy-saving equipment, lamps, water-saving sanitary appliances and other facilities and equipment are widely used. Up to now, most of the buildings have gradually entered the operation phase.

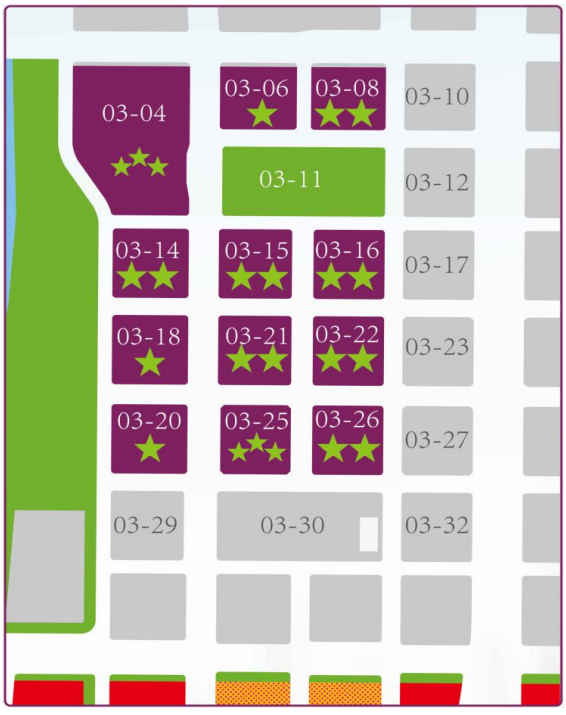


Figure 2.2.3 Star Layout of Green Building in Starting Area

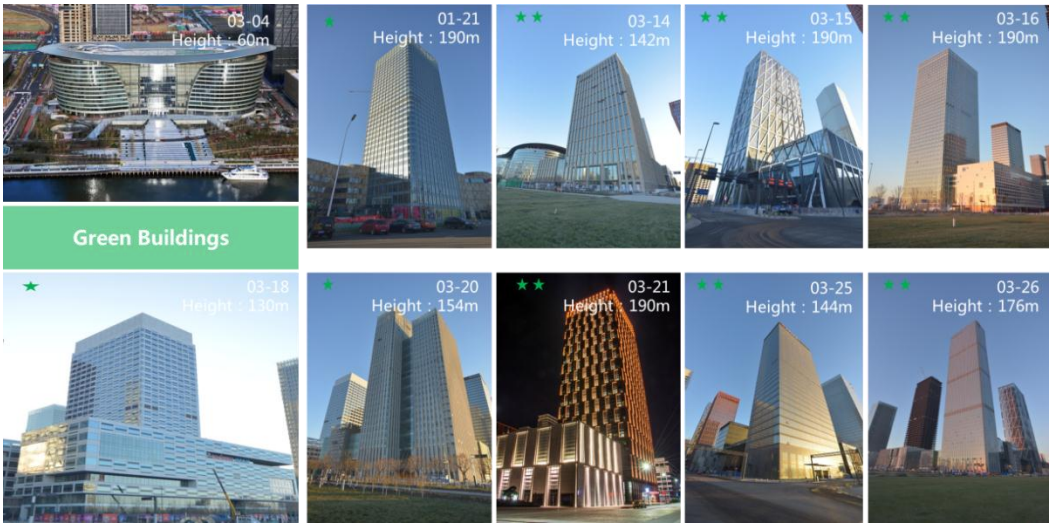


Figure 2.2.4 Streetscape of Buildings in Starting Area in Yujiapu

## 2.3 Low Carbon Transportation

Yujiapu Financial District upholds the transit-oriented development (TOD) land use model to carry out high-density land development in public transport hubs, metro stations and other public transportation developed areas. Taking people-oriented as principle, Yujiapu Financial District aims to establish a green, harmonious and pedestrian-priority non-motorized traffic network to carry out the bus priority development strategy. Moreover, coordinate the development of various functions of the road space to create a convenient and rapid traffic in the commercial area and a tranquil and safe residential traffic environment so as to achieve sustainable traffic development.

### 2.3.1Planning Concept and Mode

(1) The core concept

The core concept of Yujiapu transportation planning is green transportation, bus priority, pedestrian priority, and balance, and closely revolving around the green traffic with mutual integration and support.

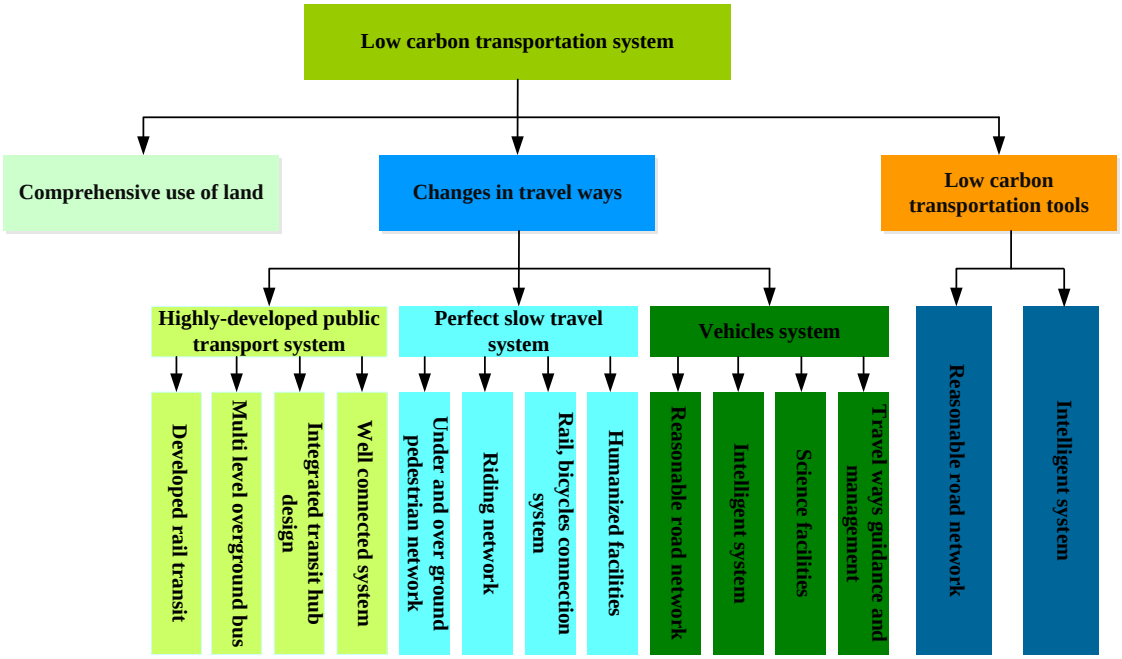


Figure 2.3.1 The Diagram of Yujiapu Green Transportation System

- Green transportation: to establish a low-carbon, ecological integrated transport system, and meet the requirement of building a resource-saving and environment-friendly harmonious society;
- Bus priority: to establish efficient and convenient multi-level public transport system mainly to meet the growing needs of residents travel;
- Pedestrian priority: taking to build a vibrant financial and business district, a strong cultural atmosphere of life, living, and leisure resorts as the goal, to establish a perfect non-motorized traffic system;
- Building a balance: With the theme of harmony, during the process of traffic planning, taking the balance of all traffic subsystems, traffic modes and traffic behaviors as principle, to establish of a pedestrian and motor vehicles, dynamic traffic and static traffic, land use and transport systems to achieve a relatively balanced comprehensive transportation system.

(2) Land development model

Transit-oriented development (TOD) land Development model: Give full play to the advantages of rapid and large-capacity rail transit, and establish a public transport system with rail transit as the backbone and ordinary public transport as the mainstay, and guide land development and promotion intensive use of land to enhance public transport service and competitiveness. The main approach is to coordinate the contradictions between the traffic jams and the shortage of land in urban development through land use and transport policies. Traffic problems are solved from the perspective of traffic flow. Under the premise of not disregarding the use of cars, focusing on cultivating passenger flow, with a view to raising the value of land, moderately high-density land development along major rail transit hubs and sites should be accompanied by housing, office and commercial, public space and other mixed use of land design, while macro-balanced urban space to guide the growth of order to control the disorderly spread of the role of the city.

(3) Travel mode

Green transportation will change people's travel mode from private means of transportation to public transportation and non-motorized transportation. Fundamentally reduce the traffic demand of regional motor vehicles and ease traffic pressure on residents' trips, and reduce traffic energy consumptions and carbon emissions.

### 2.3.2Transportation Development Strategy

- Optimize the structure of land use through intensive land use patterns, and make the public transport a dominant traffic mode;
- Reduce the need of vehicle trips and change the travel concept.
- Establish a well-functioning and rational distribution of public transport network system, especially the rail transit and large-capacity bus rapid transit;
- Advocate the establishment of a non-motorized traffic network, plan a complete bicycle system, provide a large amount of open space, using electric vehicles, public transportation, bicycles and walking as the main mode of travel;
- Relieve traffic pressure through traffic demand management means, such as providing parking spaces to guide the use of vehicles;
- Use low-emission, new energy hybrid fuel vehicles.

### 2.3.3The Planning of Road Network

The road network planning of Yujiapu adopts the planning concept of "narrow streets and dense road-network" to promote the development of living plots with “living open, appropriate scale, perfect matching and harmonious neighborhood”. Smaller parcels provide a pedestrian-friendly urban environment; a network of narrow roads forming a dense

road-network offers multiple options for walkers and motorists.

Figure 2.3.2 The Road Network Planning of Yujiapu

Yujiapu internal road network structure includes: the main road - "four vertical and four horizontal"; city secondary trunk road - "three vertical and five horizontal." The total length of the road network is 45.60 kilometers and the road network density is 11.81 kilometers per square kilometer, of which the trunk road density is 3.70 kilometers per square kilometer, the secondary trunk road density is 3.05 kilometers per square kilometer, and the branch density is 4.62 kilometers per square kilometer. The planned land network covers a total area of 1,580,754 square meters and the road area ratio is 40.95%.


Figure 2.3.3 Internal Road Network Planning Map of Yujiapu

External Road Network (Binhai New Area): Rapid Transit Transit Protection Ring: Xingang 4th Road, Zhanan Road, Tianjin Avenue, Henan-Hebei Road; North-South Transit Corridor: Central Avenue Tunnel; "Four horizontal and three vertical" main external traffic artery.

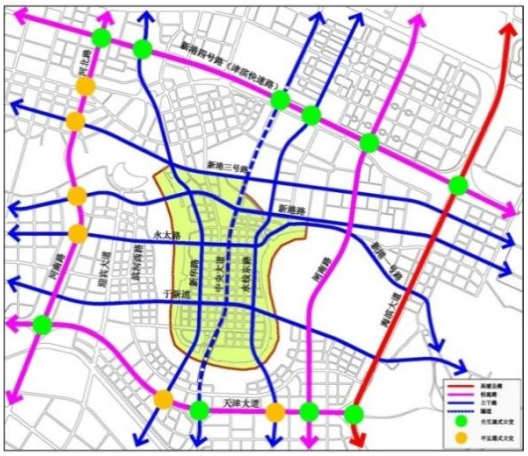


Figure 2.3.3 External Road Network Planning Map of Yujiapu

### 2.3.4High-Speed Rail Transit

Located in the north of Yujiapu, Yujiapu High Speed Rail Station covers an area of 77,000 square meters and is the terminal for Beijing-Tianjin Inter-city Railway. With a total length of 44.68 km line, it passes the Hedong District, Dongli District, to Tanggu and Yujiapu along the way. This line connects Beijing, Tianjin and Binhai New Area, to realize the public transportation usage, which it's convenient and efficient for Binhai New Area to connect with surrounding area.

Yujiapu High Speed Rail Station is the first large and all-underground transportation hub in the north of China and is the largest and deepest underground high-speed rail station in the world. It is also the world's first single-story long-span reticulated dome steel structure project. Formally put into operation on September 20, 2015 and has a 45-minute fast access to Beijing. The operation of high-speed rail transit will closely link the Binhai New Area with other cities in the Beijing-Tianjin-Hebei region and further promote the development and opening up of the Binhai New Area. To play its leading role in Bohai Rim to promote the coordinated development of Beijing, Tianjin and Hebei, and the linkage of Beijing-Tianjin twin cities is of great significance.

Figure 2.3.4 Aerial View of Yujiapu High Speed Rail Way Station

### 2.3.5Public Transportation System

(1) Planning of rail transit system

In the Yujiapu Financial District, the rail transit network is dense. We plan to build two horizontal and two vertical in total 4 urban track lines, and form 3 transfer stations and 2 interval stations. The average distance between stations is 800 meters. Two of the metro lines Z1 and Z4 are the lines to connect to the downtown city, Lines B2 and B3 are for Binhai New Area, showing a layout of "two horizontal and two vertical", in which the Z1 and B3 lines are planned for the East-West, while the Z4 line and B2 line go north to south. At present, the line B1 and line Z4 are under construction. The five metro stations will cover about 70% of the entire peninsula in the 300-meter range, and rail traffic is the main way to support the peninsula's travel, sharing 40% of the traveling.

Figure 2.3.5 Planning Map of Rail Transportation in Yujiapu

The construction of underground rail transit in Yujiapu Financial District, fully integrated the city planning of Yujiapu and Binhai New Area. During the process of the starting area's construction, the underground rail transportation infrastructure were completed simultaneously, which reduce the amount of later construction of rail transit, shorten the construction period and reduce the carbon emissions of construction.

(2) Planning of regular bus network External public transport: Bus Rapid Transit - long-distance public bus service, open express bus station etc; ordinary bus lines - medium and short-distance external traffic services.

Internal public transport: internal feeder bus - internal bus service, connecting rail and external bus station.

Tourist routes: tram sightseeing routes along Haihe River- mainly for tourism and leisure tourists.

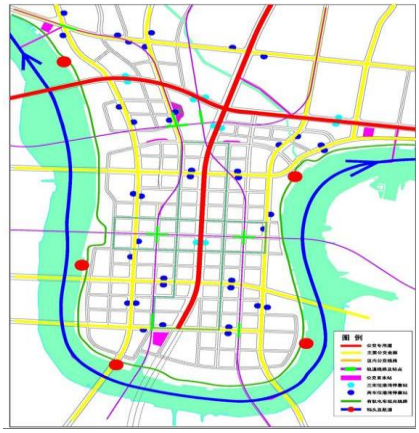

Figure 2.3.6 Planning Map of Regular Bus System

At present, a total of 5 bus lines in the starting area are started from the Yujiapu High-Speed Rail Station, and 3 bus lines pass through Yujiapu to achieve external connection. Wharf for water bus in Riverside Park has been completed; tourists can take the water bus for scenery viewing.

Figure 2.3.7 Yujiapu High-Speed Railway Bus Station and marina in Riverside Park

Sightseeing Bus——the combination of sightseeing and shopping.


Figure 2.3.8 One of the Free Bus Line to Global Go Figure 2.3.9Free Bus in Operation

Since its operation in May 2017, Free Buses for Global Go have successively operated

eight regular routes in a coordinated way. More people have more choices in their daily life. In their leisure time, they can come to Yujiapu Commercial Street at any time, pick out foreign goods in Global Go and enjoy the culture and creation atmosphere in cultural and creative community in building 03-21.

### 2.3.6Non-Motorized Traffic System

(1) Planning for bicycle network

Network classification: corridor, channel, leisure channel;

Layout of bicycle rental stations: the density is no less than 12 per square kilometer; the distance between two adjacent stations is no more than 1 kilometers; It is closely related to the main entrances of the railway stations and the main flow of public traffic and the attraction points of the key people.

Figure 2.3.10 The Bicycle Network Planning，Lane and Shared Bike Parking in Starting Area

(2) Planning for the Pedestrian Network

Figure 2.3.11 Planning and Layout of Pedestrian Network in Yujiapu Region

### 2.3.7Parking Planning

(1) Overall planning of parking in Yujiapu

The Yujiapu overall parking development strategy controls the use of social vehicles by keeping the availability of parking spaces in Yujiapu financial district within a reasonable range. Control the number of parking spaces used for work trips to guide employees not to use social vehicles to work. We should cherish the limited road resources in Yujiapu Financial District, strictly limit the parking of the roadside, completely cancel the parking of the sidewalks, and

optimize the pedestrian's walking environment. Sufficient social parking spaces are provided to support the needs of daytime business activities. Meanwhile, implementation of parking management (control of parking lot usage, time and parking fees and other measures) is a measure of traffic demand management, which guides the use of cars reasonably. Establish reasonable bicycle parking standards and bicycle parking facilities. We should encourage the development of comprehensive property, and pay attention to the sharing of different types of parking demand when the number of parking lots is built.

Use three models of underground parking garages connection (short lane connections), public parking lot underground channel and setting up special roads, to alleviate traffic pressure on the ground, and guarantee the parking space sharing in the area. As shown in figure 2.3.13

Figure 2.3.12 Layout of Parking Space in Yujiapu

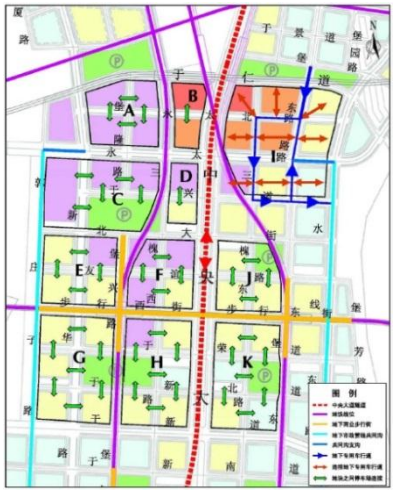

Figure 2.3.13 Connection Channel of Underground Parking Lot in Yujiapu

(2) Parking planning in the starting area

Table 2.3.1 Parking Demand of Every Plot in the Starting Area

| Plots | Available Parking Space | Demand for Parking Space | Parking Space Gap |
|---|---|---|---|
| 03-04 | 442 | 415 | 27 |
| 03-06 | 231 | 983 | -752 |
| 03-08 | 295 | 1046 | -751 |
| 03-14 | 493 | 501 | -8 |
| 03-15 | 453 | 770 | -317 |
| 03-16 | 618 | 931 | -313 |
| 03-18 | 458 | 503 | -45 |
| 03-20 | 410 | 463 | -53 |
| 03-21 | 369 | 534 | -165 |
| 03-22 | 580 | 943 | -363 |
| 03-25 | 503 | 531 | -28 |
| 03-26 | 470 | 751 | -281 |
| 合计 | 5209 | 8370 | -3161 |

Public Parking Lots: 01-14 plot; Northern Green Park of 03-11: 1250; Southern Green Park of 03-30:1264; Riverside Greenland: 184. Temporary parking Lot: Add 2-3 temporary parking lots; providing 647 parking spaces.


Figure 2.3.14 Planning of Public Parking and Temporary Parking in Starting Area

### 2.3.8Charging Facilities for Electric Vehicle

In order to encourage the use of new energy vehicles, there are 2 electric vehicle charging stations and 18 charging piles on the ground are set up. In addition, the underground charging station set in the underground parking lot in Yujiapu High Speed Rail Station.

Figure 2.3.15 Charging piles on the ground and underground special parking space

## 2.4 Low Carbon Energy

### 2.4.1Planning of Yujiapu Cooling Center

Seven cooling centers are planning to be constructed for providing greening cooling services for the business offices, financial institutions, apartment buildings and commercial buildings in Yujiapu Financial District. The total service area is 6.9 million square meters, accounting for 72.9% of the planned construction area, with an average service area of 864,000 square meters. Energy system must be independent of the construction industry, such as hotels and apartments, its self-built energy station service area of about 2.593 million square meters, accounting for 27.1% of the total planned construction area.

The maximum supply radius of Yujiapu regional energy station is 1 km; the average supply radius is 0.5km. The energy system is supplemented by regional energy stations and self-built heating and cooling machines. Make full use of the complementary characteristics of single building air conditioning load, saving investment of cooling and heating source and cooling and heating room construction area; using the technology and equipment of high efficiency to achieve professional combined assimilation management, in order to save energy and reduce carbon emissions, reduce operating costs.

Figure 2.4.1 Centralized Energy Station Planning in Yujiapu Financial District

### 2.4.2Cooling Technology

The district cooling in Yujiapu is based on ice storage technology and system energy saving control energy. To build a plant for producing and storing cooling in concentrated areas people who need the cool air to provide cooling air by the public cooling pipe network.

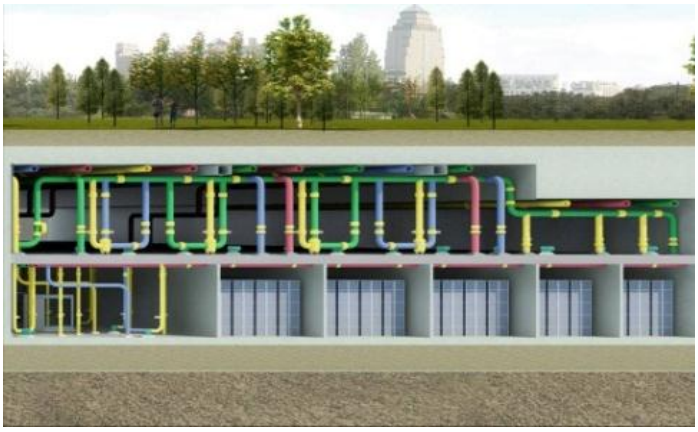

Figure 2.4.2 Ice storage

Ice storage technology is the use the low power at night time, use the low-cost electric to ice and store cool; at daytime, and melt the ice at peak in energy demand and chillers co-cooling. In the daytime, when the air conditioning is in the peak-load, release the cooling storage to meet the need of peak-load air conditioning.

The cooling source of air conditioning in all buildings is ice storage system. The form of ice storage system includes series, chiller upstream, external melt and fractional ice thermal storage. The system is equipped with two centrifugal electric refrigerating chillers as the basic loader and eight centrifugal dual operation refrigerating chillers as the refrigerating main engine. The system is supplied through the two pipe outdoor pipeline network to the single building through the plate heat exchanger set up in the single building.

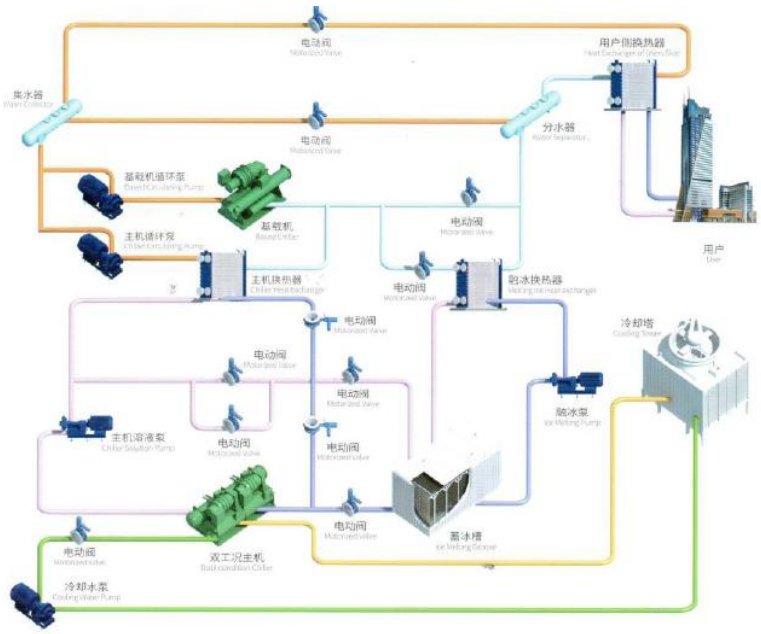

Figure 2.4.3 Cooling Technology Flow Chart for North Cooling Center in Yujiapu

### 2.4.3Operation Status

03-11 cooling center project is located in the underground of North Park in starting area phase one in Yujiapu Financial District, covers an area of 4956.8 square meters, and the construction area is 10583.9 square meters. This cooling center provides cooling service for 11 buildings and underground space in the starting area. The total cooling load is about 90000kW and the cooling service area is about 1,193,900 square meters.

According to the rule of building utilization, based on the hourly overlay of building's cooling load in energy station, the comprehensive maximum cooling load is determined, that is, the design daily peak value of cooling load is 114.33MW, and the cooling load of base carrier is 5736kW.

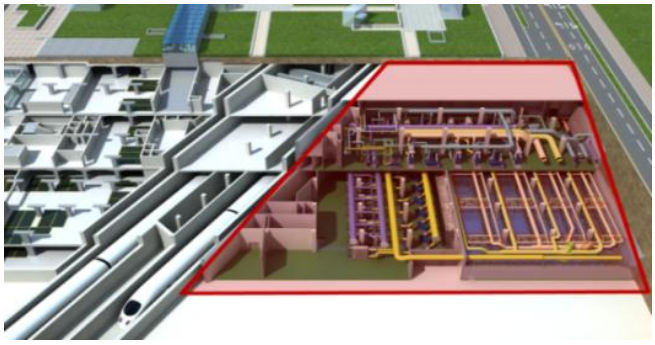

Figure 2.4.4 The Floor Plan of North Cooling Center

The North Cooling Center phase one was officially launched on May 13, 2016，has provided for 270 thousand square meters cold demands. North Cooling Center Phase II equipment has been arranged for procurement, scheduling to prepare for cooling in 2018. Combined the mobile Internet and intelligent management platform, the north cooling center adopts the automatic remote intelligent control system throughout the entire process to accurately locate the maintenance information of the pipelines and equipment. The operation management is fully automated and digitized to realize smart operation and green management.

Figure 2.4.5 Operation Site of Yujiapu North Cooling Center

### 2.4.4Management Mode

The north cooling center in 03-11 in Yujiapu Financial District is invested by Tianjin Innovative Suez Energy Investment Co., Ltd. as the main body to undertake the design, investment and construction. After drawing on advanced experience both at home and abroad, we are committed to building a high-quality regional cooling network and providing high-quality cooling services to customers in the cooling area at the promised price and energy efficiency. The entire energy management process is based on the plan-do-check-improve (PDCA) model to improve continuously that integrates energy management into the organization's day-to-day management activities. To achieve the energy policy set by the energy station, the energy target is implemented and standardized energy management procedures are established, including control procedures for energy performance parameters, energy assessment, energy management implementation plan and energy operation, as well as energy usage diagnosis, energy monitoring measurement and analysis , power equipment operating procedures and other management procedures to ensure continuous improvement of energy management methods to improve energy performance.

## 2.5 Underground Space

The planning of underground space in Yujiapu Financial District is aimed at the intensive use of land, optimization of traffic organization and centralized layout of municipal pipelines. The planning function is mainly focus on transportation and commerce, and also has the functions of culture, leisure, parking and disaster prevention. The underground space within boundary line of building is nearly 4 million square meters; the overall planning of underground has been basically stable. The man set of underground includes commerce, garage, equipment space and supporting service facilities for the specific projects; the total area of public roads underground space is nearly 200,000 $m^2$ with underground vehicle system, underground pedestrian system, underground commercial system, common ditch system, and rail transportation system.

(1) Planning concept

• Give full play to traffic functions in underground space and achieve the development target of " transit-oriented " in the city;

• Intensive use of underground space resources to enhance the value of land;

• Create three-dimensional urban space to improve the quality of urban environment;

• Improve the city function to alleviate the traffic pressure.


Figure 2.5.1 Master Plan of Yujiapu Underground Space

(2) Development strategy

In order to take both economic and social benefits into account, comprehensive development will be carried out in Yujiapu Financial District underground space to realize the concentration of land, function and capital so as to achieve the purpose of efficient use of land, environmental protection and convenient transportation.

• Integrated and complex development of various functions, such as commercial, parking and municipal functions, in order to maximize the economic, social and environmental benefits.

• The concept of pipeline operation is used to organize systems to reduce interference between systems, and improve the operation efficiency of underground space systems, that is the separation of underground pedestrian, vehicle and municipal systems in horizontal and vertical ways.

The underground space planning of Yujiapu Financial District specifically includes:

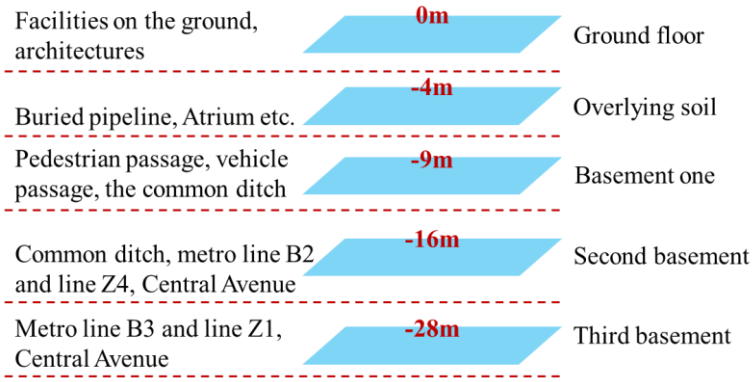


Figure 2.5.2 Diagrammatic Sketch of Yujiapu Multi-Space

The first part is a 4m mezzanine between the ground floor and the basement. The functions include the basement of the building, the buried municipal pipelines, the urban atrium and the pavilion;

The second part is basement one, including the building basement, the underground public parking lot, the central tunnel, the underground business, the underground pedestrian passage, the underground vehicle passage, the common ditch and the metro station, the bus terminal station and so on;

The third part is second basement, including the North-South metro, the underground train passage, the central tunnel, the railway station platform, metro station channel and other facilities;

The fourth part is third basement, including east-west metro, metro platform and other facilities.

During the planning and construction of underground space in the starting area, centralized planning is used to effectively utilize land resources, and at the same time, unified development mode is adopted to reduce development cost and avoid reconstruction after completion.

Figure 2.5.3 Unified Planning Comprehensive Development

### 2.5.1Underground Travel

(1) Underground pedestrian system

Taking rail transit as the core and based on the important traffic diversion points, the planning of underground pedestrian system focuses on the underground space around the starting area, the commercial development axis of Central Avenue and the surrounding underground space, the space around Yujiapu High Speed Rail Station, the surrounding areas of each group center (around the subway station) underground space. The usage of traffic anchor point, combined with the layout of the ground function, forms a convenient ring system in the shallow underground area as shown in Figure 2.5.4.


Figure 2.5.4 Underground Pedestrian System Planning of Yujiapu Starting Area

(2) Underground vehicle system

The planning concept of the Yujiapu underground vehicle system is to develop commercial office buildings with high strength through the underground vehicle line system to reduce the pressure on the ground traffic. Connecting the underground parking garage with high strength development is conducive to the sharing of parking resources, and smooth and continuous one-way traffic can greatly improve the ability of internal traffic release.


Figure 2.5.5 Underground Vehicle Planning of Yujiapu Starting Area

At present, the Haihe River-Central Avenue tunnel has been fully opened, and the maintenance structure of Xinhua Road underground vehicle system in the starting area has been completed.

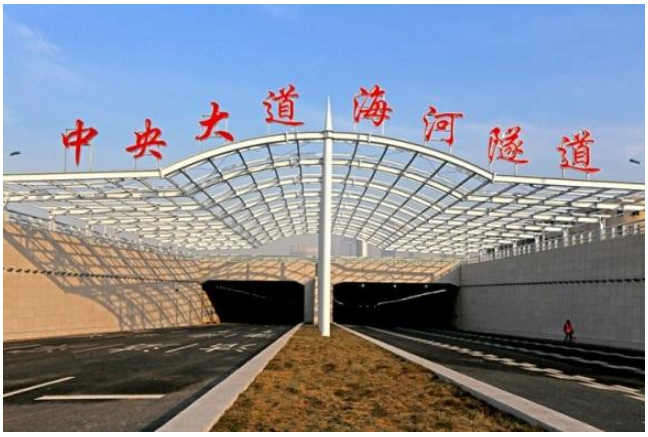


Figure 2.5.6 Haihe River-Central Avenue Tunnel

(1) Underground parking lot

The underground parking lot is set up in all the buildings in Yujiapu and the north and the South Park. The underground passageway can connect each plots and parking lot to realize resources sharing and improve the use rate of the parking lot to alleviate the parking difficult problems. At present, all the underground parking lots in Yujiapu Starting Area have been completed. Some of the parking lots and underground parking lot in the north park in 03-11 have also been put into operation. The underground parking lot of South Park in 03-30 has been in the decoration phase.

Figure 2.5.7 Intelligent Underground Parking Sharing in North Park

(2) Underground rail transit

The rail transit network of Yujiapu Financial District is intensive. 2 horizontal and 2 vertical altogether 4 city rail lines are planned to be constructed and form 3 transfer stations and 2 interval stations. The average distance between stations is 800 meters, in which the Z1 and B3 lines are planned for the East-West, while the Z4 line and B2 line go north to south.

During the whole development and construction of underground space, the construction and reservation of related infrastructure of Yujiapu rail transit system has been completed, providing convenience for the introduction of rail transit.

### 2.5.2Underground Commerce

The underground commercial street in Yujiapu is supported by rail transit, taking the metro transfer hub as the core, connected to Yujiapu High-Speed Railway Station, and the underground walking plot is reasonably distributed. To the north is building 03-06 and north of building of 03-08; to the south is Sunken Square of south garage; to the west is building 03-18 and west of building of 03-20; to the east is building 03-22 and east of building 03-26. The length of north-south is about 669 meters, and the width of west-east is 422 meters. The total area of first phase is 20,000 $m^2$ with more than 20 stores.

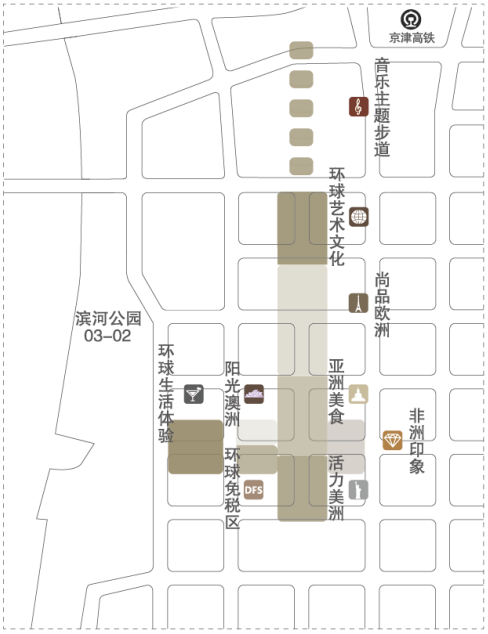

Figure 2.5.8 The Layout of Yujiapu Underground Commercial Street

In 2015, Yujiapu underground commercial street has been put into operation, taking the “Yujiapu Global Go” as the theme, which enables you to shop all around the world without stepping out your door for the residence in Jing-Jin-Ji and Binhai New Area, and the staff in the free trade zone.


Figure 2.5.9 Underground Commercial Street of Yujiapu Global Go

The underground commercial street mainly includes global art and culture, European products, Asian cuisine, African impressions, vitality Americas, sunshine Australia, bonded exhibition, global life, parallel import vehicle exhibition and exchange, etc. In the meantime, Binhai New Area's overall commercial atmosphere has been enhanced by bringing together information resources such as high-quality goods, tourism, art, culture and automobiles all over the world and has become a new business card in Binhai New Area.

### 2.5.3Common Ditch of Pipe Network

In order to improve the utilization of Yujiapu underground resources and durability and safety of underground pipelines, to facilitate the operation and maintenance of pipelines, the common ditch of pipe network is planned to construct to make full use of underground public space under city roads to achieve common excavation section, function gathering, land conservation, engineering, economic and reasonable. The planned total length of the common ditch is about 11 kilometers and consists of two main lines of east and west and a number of branches of streets that cross the road. The main ditch is a common ditch. In order to realize the integrated management of common ditch in Yujiapu, a comprehensive monitoring system should be set up. The main supporting facilities of common ditch such as vents, feed openings, entrances and exits can be combined with the setting, and should be set in the sidewalk, road test green belt, or with the rest of the ground building.


Figure 2.5.10 Planning of Yujiapu Common Ditch

At present, the construction of the common ditch phase one has been completed, the scape of phase one includes south of Yongtai Road to Yuxin Rouad, east of Ronghe Road to Pujing Road. The service area is about 0.3 square kilometers, and 900 meters long, which divided into two cases, which include electric power, communication and heating. The following picture is the scope of service and the sketch map of the first phase of common ditch.

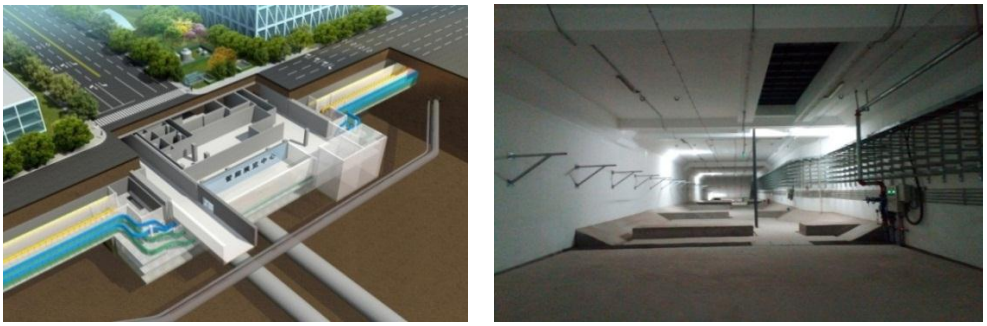

Figure 2.5.11 Diagrammatic Sketch of Section of Yujiapu Common Ditch

## 2.6 Low Carbon Landscape

Yujiapu has created a continuous and organic network of open space. The street design is based on the principle of pedestrian priority and links the open space of every plots. The building courtyard and the street landscape echo each other, enriching the pedestrian's street life. At the same time, the green park has become the landmark in Yujiapu, providing a comprehensive venue for activities to increase carbon sinks, and the quality of people’s life in cities and nearby.

### 2.6.1Planning Concept

(1) Planning guidelines of landscape

For Yujiapu landscape planning introduced into the concept of urban living room, the entire of Yujiapu Financial is like a magnet, with its diverse highlights and attractions; the open space likes the living room of the city, which has become a place for people live and play.

As the core of the Binhai New Area, the open space system of Yujiapu Financial District will provide a new way to improve the quality of people’s life at all ages in the city and its vicinity based on the principle of people-oriented. The landscape opening system is the name card and sign of Yujiapu.

In the landscape design process of Yujiapu Financial District, the low carbon strategy is fully used in combination with the concept of the sponge city. In the construction process of Riverside Park, North Park and Central Avenue landscape belt, a series of low carbon measures such as ecological ditch, rainwater collection system and permeable ground are applied. At present, the landscape of riverside park, the North Park, the Central Avenue in starting area have been put into use, the South Park is in the implementation of the construction.

(2) The principle of landscape design

- To improve the overall regional value and create the unique city card of Yujiapu by the sustainable development strategy and the concept of dynamic city. We use locally produced resources such as plants, stone and timber to create sustainable riparian landscape. By creating a dynamic and attractive Haihe River landscape, we can reflect the overall image of Central Business District and promote regional prosperity.
- People-oriented. People-oriented, the landscape design of the Haihe River must take age, interests and needs of different people into account, which can provide a rich, diverse,

beautiful, comfortable and pleasant public space for public life; meet the needs of different groups, reflect the spirit of humanism.

• Retain the characteristics building, keep the development history and urban memory. The combination of the sculpture of natural landscape and the protection and utilization of cultural landscape, and the maintenance of the continuity of historical context; to restore and improve the vitality of historic buildings along the Haihe River landscape, and mining is its historical value; through the exhibition connection of cultural elements to praise the long history and cultural heritage of Yujiapu and ultimately lead the characteristics of the new town in the future.

• Strengthen the connection between the new town and the waterfront. To improve the accessibility and the hydrophilic of citizens with waterfront space landscape; strengthen the design and connection between city and river; strengthen the structural system of the island's public space, improve the relation of integral space. Under the framework of the overall system, the regional functions should be considered in a comprehensive way. The landscape planning should strengthen the connection with the surroundings and enhance the regional value in an all-round way. The landscape design should take the initiative to strengthen the functional connection with the adjacent areas to achieve the integrated function configuration; The function of the park along the river is closely related to the adjacent plots, making it the expansion function space for the adjacent plots, appropriately emphasizing the individuality of each district, and considering the overall function of the riverside park.

• The principle of safety. Although the design forms, material selection and details of the environment should reflect the humanized safety of landscape design, the landscape design along the river is based on the premise of not undermining the safety of urban water system, that is, reliable water supply, flood control safety and ecological balance.

(3) The framework of open space in Yujiapu Financial District

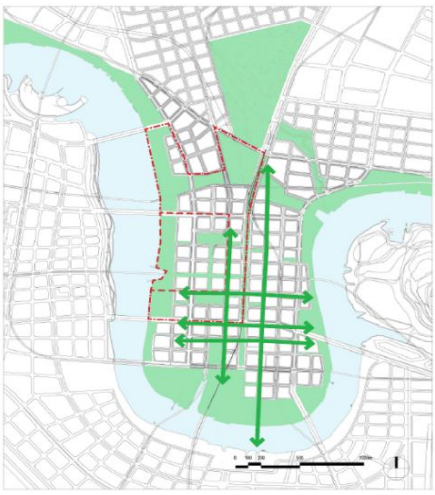

Figure 2.6.1 The Framework of Open Space


Figure 2.6.2 General Landscape Planning

Yujiapu Financial District has a unique special advantage, that is, its large open space system surrounded by water on three sides. Starting from the inter-city railway station and the Ziyun Park, through an 80-meter-wide central avenue, two pedestrian streets and a series of park-side green belts connect, to Riverside Park with an average of 150 meters wide, and continue to Haihe River. The parks and green belts in this series of open spaces are not independent green space units. Instead, they are a continuous and organic network. This open space system will bring the city a rich, healthy and beautiful environment which will benefit the city in many ways, and effectively enhance the quality of urban life.

(4) Functions

The regional functions of Yujiapu Financial District include: Music Plaza, hotel garden, ecological park and Sports Park. Function settings are combined with the surrounding area to suit local conditions, forming specific regional functions.

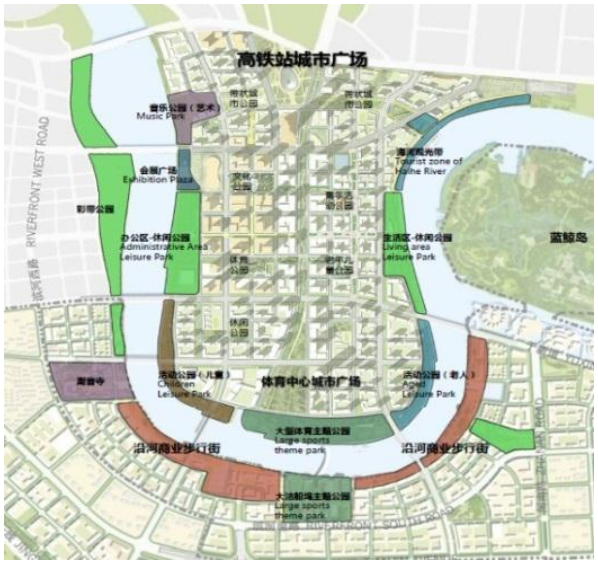


Figure 2.6.3 The Functions of Yujiapu Open Space

**2.6.2Streetscapes**

(1) Pedestrians' priority streets

The design of the streets in Yujiapu provides a continuous and uninterrupted open space system, creating a comfortable and pleasant walking experience for pedestrians. It also provides specialized public transport and bicycle lanes to encourage the use of street space and street life.

Figure 2.6.4 Road Classification Map of Yujiapu Starting Area

A pedestrian dominated city, the experience of the street is the common experience of the city. Therefore, we should emphasize the link between streets and open spaces in the road classification to further reinforce the concept of urban living rooms.

Figure 2.6.5 The View of Central Avenue Landscape Belt

(2) Interaction between architecture and open space

To use the conditions of each plot provides the inner court, and the connection between the inner court and the street landscape should be modestly strengthened to enable pedestrians to use the building's courtroom, develop more walking routes and further enrich the street life.

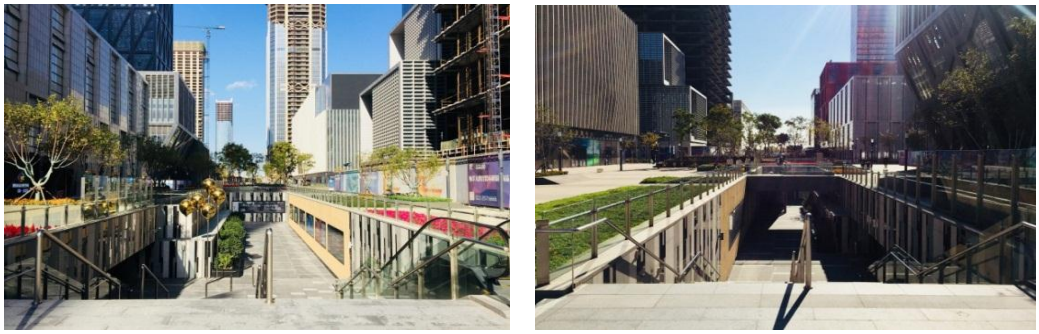

Figure 2.6.6 Building Sidewalk and Cross Pedestrian Street in Staring Area

(3) The planning and design of water

The rainwater runoff is collected through the side ditch by using roadside green belts. Surface runoff is purified through the soil layer of the green belt, and the rainwater discharge system is confluence to the city to reduce the pollution burden of the discharge place. The system can also reclaim runoff and turn it into irrigation water to reduce the burden of urban water use. In addition to the street system, the urban open space system, such as the park of the house and the green belt, is part of the overall planning of the rainwater management.

Figure 2.6.7 Permeable Ground of Leisure Path

**2.6.3Park Landscape**

(1) Riverside Park

The Riverside Park in Yujiapu Financial District is an important part of the public space system. The Beijing-Tianjin inter-city high speed railway connects Yujiapu with Tianjin and Beijing and the Riverside Park becomes the postcard of Binhai New Area. The park is positioned as an open, green and dynamic space that balances the density of urban development in Yujiapu. Taking low carbon demonstration as principle, the low carbon design strategies are incorporated in planting strategies, carbon sequestration and oxygen release plants, irrigation methods, rainwater harvesting, floor covering, urban furniture and low-carbon humanities promotion in Riverside Park, which form the low carbon cultural demonstration effect.

Figure 2.6.8 Riverside Park under Construction in 2013

Figure 2.6.9 The Completed Riverside Park in 2017

Riverside Park has been put into use. There are jogging, walking, bicycles, skateboards, fountain games, lunch, sports and boat watching. It also provides lots of opportunities and facilities for walking and bicycles in parks, so as to encourage the use of park paths and sidewalks.

Figure 2.3.10 Cycle Way in Riverside Park

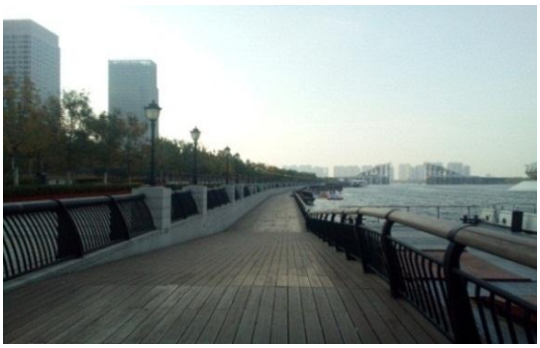

Figure 2.3.11 Leisure Path along the Haihe River

The riverside park fully adopts the tactics of rainwater garden, ecological grass ditch and rainwater collection module to recycle the purified rainwater for irrigation.

Figure 2.6.12 Rainwater Garden

Figure 2.6.13 Rainwater Collection and Storage Module

(2) North and South Park

- North Park

North Park is the east-west axis green belt between the Central Avenue and Riverside Park, and the intersection of the north-south axis green belt of the pedestrian street. It mainly serves the surrounding office buildings, exhibition centers and Exhibition Hotels. At present, North Park has been put into use, as shown below.

Figure 2.6.14 The View of North Park

North Park incorporates a variety of civic activities, providing civic and community gatherings with the primary purpose of walking, such as social opportunities, open markets, music and other cultural performances, as well as provides space for the outdoor assembly site next to the conference center. North Park has created a semi-intimate range of gardens, providing one-night rest for surrounding staff.

- South Park

South Park, which mainly serves the surrounding office buildings, educational institutions and serviced apartment, mainly to establish the atmosphere of the neighborhood park, and public art to emphasize the cultural identity and create a sense of place. By creating a small gathering space, play area for leisure or friends as well as the space around the office staff afternoon resting places; it is the diversity of landscape of the city park, mixed type can be integrated into various activities and meetings. At the same time, considering the use of different cultural groups for urban parks, the South Park shows different needs through the design of the project portfolio. At present, the South Park is under construction and is expected to be completed next year and open to the outside world.

Figure 2.6.15 Renderings of South Park

(3) Low carbon strategy of Parks

In the landscape design process of Yujiapu Financial District, the low carbon strategy is

fully used in combination with the concept of the sponge city. In the construction process of Riverside Park, North Park and Central Avenue landscape belt, a series of low carbon measures such as ecological ditch, rainwater collection system and permeable ground were applied. Such as the riverside park overall strategy: using low carbon storage wells, ecological grass ditch, water treatment system for rainwater collection system, the collected rainwater through the recycling water treatment system is centralized to Yujiapu; storage system is established to make full use of solar energy, such as solar lavatory, solar science popularization system, solar charging station; terminal retains the original version, make full use of the existing material redesign; simplify the design that is easy to construct, all materials are taken from within 500 km to reduce loss.

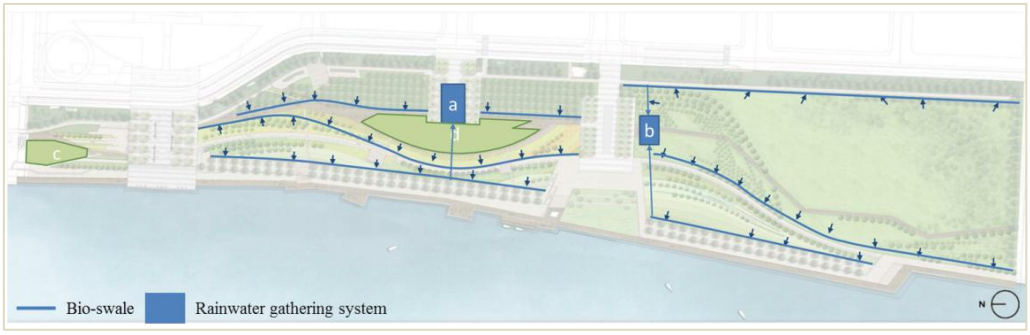


Figure 2.6.16 Ecological Grass Ditch Rainwater Recovery System In Riverside Park

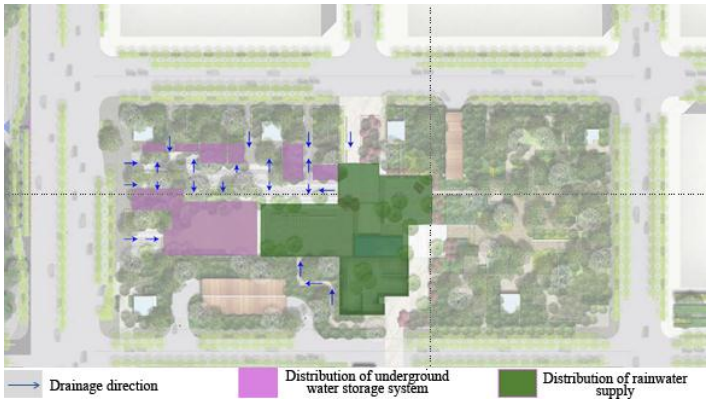


Figure 2.6.17 Schematic Diagram of Rainwater Collection System in North Park

### 2.6.4Demonstration of Urban Agriculture

Urban Agriculture Demonstration Base in Yujiapu Financial District is located on the roof of 03-21 Podiums, which is an important technical route for the construction of Low Carbon Model Town in Yujiapu Financial District. It's also one of the key strategies for reducing carbon sources and increasing carbon sinks in Yujiapu. On one hand, green and low carbon measures can be used to release carbon dioxide; on the other hand, intelligent agriculture, such as rainwater harvesting, dust removal and noise reduction, and short chain transportation, can save energy and reduce energy consumption.

The total implementation area of Urban Agricultural Demonstration Base is 4111.1 square meters, divided into three zones that is Zone A, Zone B and atrium Zone. The plant area of rooftop agriculture is about 1,500 square meters. The design follows the stripe style of Innovation and Entrepreneurship Building and adopts the integrated rooftop farming system developed by Tianjin Innovative Finance Low Carbon Institute. It integrates micro-climate

simulation, stubble design, planting module, the Academy of Agricultural Sciences and the integration of lightweight substrates and automatic water and fertilizer irrigation system, the technical characteristics of the formation of planting green can be modular, landscape edible, food Safety traceability, continuous recovery of growth and harvesting.

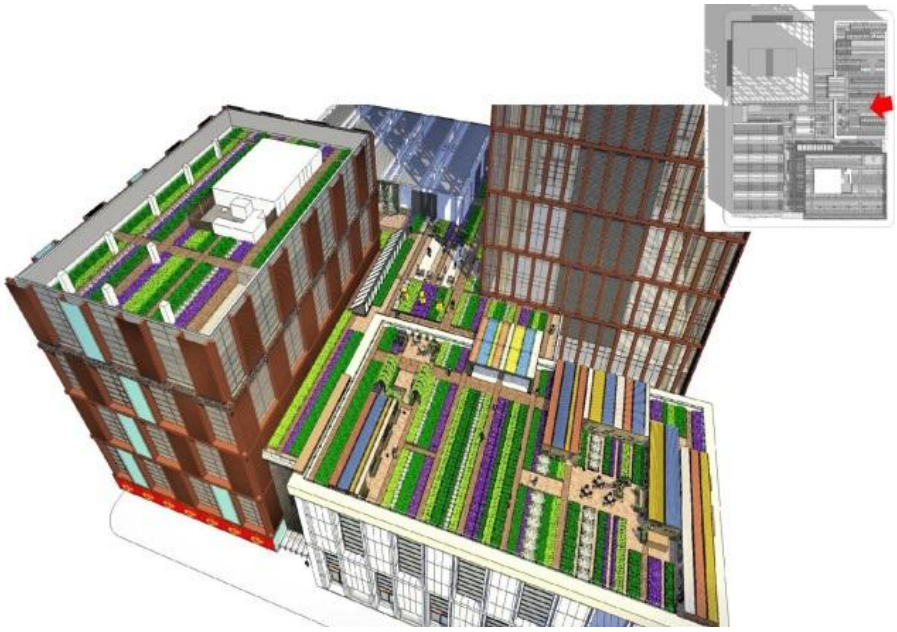

Figure 2.6.18 The Planting Layout of Rooftop Garden in 03-21

In the practice of APEC Low Carbon Model Town in Yujiapu, urban agriculture demonstration base has set a model of sustainable development elements such as the Fifth Elevation, green office, interactive business, creative classroom, ecological energy saving and organic health for the economic development of building in Yujiapu. The base, as a fruitful result of constructing an environment-friendly society in the Yujiapu Financial District has received keen attention and guidance from the leaders of Central Business District, leader of Binhai New Area, leaders of Tianjin Municipal Government and other relevant departments concentrating on the building of low carbon Yujiapu which also contribute to the construction of the Beautiful China.

Figure 2.6.19 The View of Rooftop Garden in Plot 03-21

The 03-21 urban agriculture demonstration project combines the construction and agriculture with new technologies, the first roof garden at the top of the podium in the plot 03-21 will be built to increase the space for three-dimensional greening and try to use urban vertical agriculture to further increase the urban carbon sink area and reduce the city's carbon level. The base was the first to plant all kinds of vegetables and got a good harvest in 2015.

Through the demonstration effect of the formation of plot 03-21, a distinctive urban landscape is formed in the densely populated cities and gradually replicated and popularized in other plots.

## 2.7 Public Service Facilities

Under the background of aging and informatization, the community public service facilities should meet the diverse needs of the modern community to improve the basic and guaranteed services, enrich and upgrade the service, and guide residents to form a green, healthy and socially shared lifestyle.

Construct a reachable and energetic facility circle to realize the high-efficiency fit between the layout of facility space and residents' walking characteristics and the frequency of facility use. The first step is to meet the walking correlation degree, to connect the trails between facilities, to emphasize the creation of the walking environment, to promote residents to travel more slowly and interact with each other, so as to form a green healthy and interactive life style.

Table 2.7.1 Service Scope of Different Social Life Circles

| Community Living Circle | Service Population | Working Distance |
|---|---|---|
| 15 Minutes | 50,000 People | 800-1000 Meters |
| 10 Minutes | 15,000 People | 500 Meters |
| 5 Minutes | 3000-5000 People | 200-300 Meters |

The Planning of Community Living Circle Services Facility

The circle of 15 minutes, 10 minutes and 5 minutes in community life circle was used to serve the different sizes of population, walking time and walking distance. In evaluating the shortcomings of community public service facilities, the focus is on the distance of walking distance, the coverage of service and searching for the blind area of service.

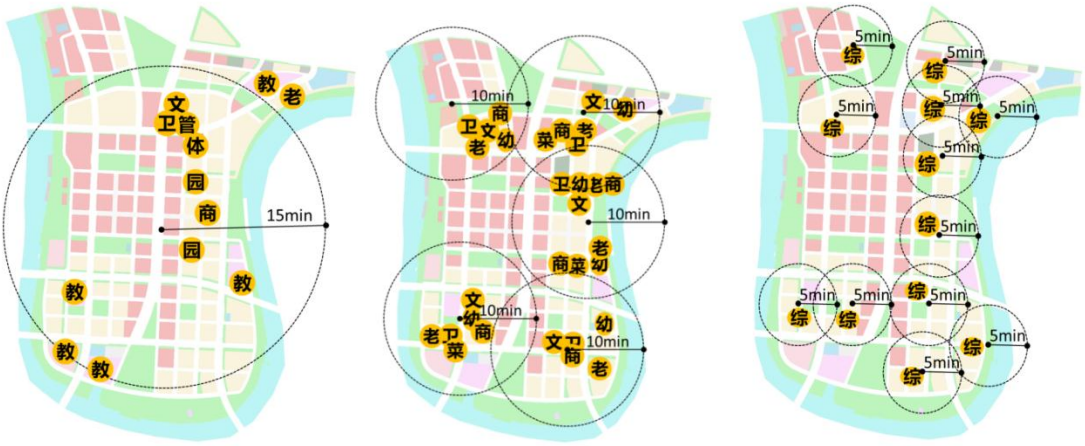


Figure 2.7.1 Different Social Life Circle Service Facilities Map

## 2.8 Resources Reuse

### 2.8.1 Waste Sorting and Recycling

(1) Categorical plan

The main types of waste produced in Yujiapu Starting Area are product packaging

(express), kitchen waste, wastepaper, waste newspaper and plastic bottles. According to the requirements of “Classification treatment, source reduction," the four major categories are recyclable waste, kitchen waste, hazardous waste and other rubbish.

Recyclable waste includes waste paper, plastic, glass, metal, cloth. Waste paper mainly including newspapers, periodicals, books, all kinds of wrapping paper, office paper, advertising paper, paper boxes and so on. Plastic mainly includes all kinds of plastic bags, plastic packaging, disposable plastic lunch boxes and tableware, mineral water bottles. Glass: including a variety of glass bottles, broken glass, mirrors, and thermos bottles. Metal mainly includes tin cans, used electronic products, cans and other boxes. Cloth: mainly including waste clothes, tablecloths, towels, school bags, shoes and so on.

The kitchen waste includes the tea residue, leftovers and other food wastes, kernels of melon and fruit peel, the remnants and deciduous leaves of plants, such as bonsai, waste edible oil and so on.

Hazardous wastes include waste batteries, waste fluorescent tubes, printer ink boxes, expired drugs, expired cosmetics, hair dyes, insecticide containers, waste mercury thermometers, waste oil drum, selenium drum and so on.

Other wastes include wasteland, waste plastic wrap/bags, cigarette butts, old ceramic products, disposable cups, toilet wastepaper, paper towels etc.

(2) Propaganda program

- Prepare and disseminate brochures on waste classification knowledge to the households. The content of the brochure should be as exhaustive as possible, including all kinds of common waste types in all office buildings, and their classification should be consistent with the classification garbage boxes set up in public places and the collection and processing classification at later stage.
- To hold lecture, and elect the garbage classification instructors in the floor to publicize and supervise the classification of garbage.
- Public poster of garbage classification is posted in public areas.
- The detailed contents of the garbage classification are posted on the floor (or at the place of classified garbage cans) so as to correctly guide people's garbage classification.
- Make introduction video of waste classification knowledge and invite public figures to take the lead demonstration.
- Launch Wechat Subscriptions related to waste classification, promote the waste classification by using the new media communication platform. QR Code are printed on Publicity posters and each leaflet, people can follow the subscriptions by scan the QR Code.

(3) Management and recovery scheme

According to the actual environment and the characteristics of the buildings, we plan to purchase and place garbage sorting facilities by the Property Management Company, and build the most suitable waste classification and recovery mode for each floor. The amount of recycled goods and garbage collection can be recorded as much as possible so as to effectively control and supervise the classification of various units of garbage.

Figure 2.8.1 Public Area Waste Sorting in Innovation and Entrepreneurship Building

Scheme one for office area: Put the classified garbage cans (recyclable waste, kitchen waste, hazardous waste and other waste) in the floor. Each business unit will go to the designated place to draw the real name garbage bag with QR Code, classify it inside the company, and put it into the classification trash bin, and then Property Management Company will reclaim it.

Scheme two for office area: The property company uniformly distributes the degradable classified garbage bags, and classifications inside the enterprises themselves. Then, the property companies collect the garbage regularly and collect the records accordingly.

In the hotel apartment area, trash cans (recyclable garbage, kitchen waste, other rubbish and harmful garbage) are placed in the elevator room on the floor, and biodegradable garbage bags (recyclable garbage, kitchen waste, Other garbage) and set garbage disposal area.

In the catering area, the kitchen waste bins, the recyclable garbage boxes, other garbage boxes, and the hazardous waste disposal areas are placed in the shops. It is suggested that the kitchen waste disposal equipment should be set up so that the garbage can be treated in situ, and the fertilizer can be used as landscape greening and urban agriculture.

In the public areas (shopping malls, squares, streets, etc.), the separate bin (recyclable garbage and other garbage) are placed.

Establish links with qualified waste resource recovery companies to sort recyclable and hazardous waste, and other waste will be transported to destructor plant by municipal departments.

Establish long-term cooperation with online electricity suppliers and make full use of recyclable resources. ( Courier bags, packaging boxes, etc.)

(4) Demonstration scheme

- Kitchen waste recycling. A kitchen waste recycling and processing station is set up. The kitchen waste produced in the office building is digested locally, after being processed; it is made into organic fertilizer, which can be used for municipal greening or rooftop agricultural projects, so as to form the resource reuse of garbage.
- Set up the garbage automatic classification machine. In the underground commercial street, to set the automatic garbage sorting machine, pedestrians can carry the recyclable garbage according to the garbage automatic sorting machine prompted to complete the classification of storage, that is, not only to carry out the purpose of knowledge of garbage classification, but also to achieve the actual effect of garbage classification.

(5) Measure of safeguard

- Publicity and training. On the basis of the careful guidance of the garbage classification, the popularization and strengthening of the classification knowledge are carried out, while supporting the reward and punishment measures are also carried out. To support and encourage the research and development of sorting processing technology, to train the property sorting workers to carry out professional knowledge and skill operation, and to establish the support system of scientific and technological talents.
- The combination of rewards and punishments. For those organizations that do not actively cooperate with garbage sorting, they should be classified and instruct, educate and punish severely. The right and active garbage classification units will be rewarded by property.
- Responsibility commitment. In order to ensure the effective implementation of the garbage classification, the garbage classification promises are signed with the service industries, such as the office area renting units, restaurants, hotels, and large shopping malls.
- Supervision and inspection. The relevant departments should strengthen the follow-up effect supervision and inspection for the implementation of the plan, carry out mid-term evaluation and final inspection every year, and propose solutions in time for the new situations

and new problems in the implementation of the plan.

### 2.8.2The Utilization of Living Sewage Water and Rainwater

(1) The utilization of living sewage water

Using recycled water to solve the problem of non-drinking water such as roads, greening, rushing cars and flushing toilets, the reclaimed water supply is provided by the water supply plant of Tianjin (China) Water Development Co., Ltd. For example, the utilization rate of non-traditional water source in 03-21 massifs is up to 54.2%.

(2) The utilization of rainwater

Yujiapu Riverside Park rainwater reuse system set 330$m^3$ water storage module volume, covers an area of about 140 square meters.

## 2.9 Smart City

(1) The technical structure of the smart city in Yujiapu

The intelligent city planning of Yujiapu Financial District is designed based on unified system architecture, namely, the perception layer, the network layer and the application layer.

- The layer includes a variety of sensing terminal equipment deployed in hotels, office buildings, public facilities, convention centers, financial trading venues, commercial, underground space, substations, common ditch and other public areas.
- The network layer should include indoor and underground space of the multi system combination platform, outdoor macro and street base station, Wi-Fi coverage system, network integrated access system, mobile communication system, the system of network coverage in industry and satellite.
- The application layer should include smart card system, smart building system, smart low-carbon energy management system, smart public service system, smart security system, intelligent transportation system, smart knowledge enterprise value-added service system and smart Yujiapu center and so on.
- The Yujiapu smart city system should be based on the technical framework of "common platform + application subset" approved by the ISO/IECWG7 international standard organization. The common platform includes common hardware platform and common software platform. Among them, the general hardware platform should include chip level common platform, module level common platform and gateway level common platform at different levels. The common software platform should include basic support platform and application service platform.
- Yujiapu smart city system application subset should be built for different needs for government users, public users, building owners, property management users and operating users based on "a center, a platform, a network, a card " through a variety of network access methods to gain access to a variety of network access for sensing Yujiapu.

(2) The functional structure of the smart city in Yujiapu

The smart city supporting network system in Yujiapu should include triple play wired access and optical transmission system, mobile communication outdoor coverage system, mobile communication indoor coverage system and WIFI coverage system. The smart card system integrates functions such as employee attendance, personnel access control, conference service, regional positioning and parking card, and the establishment of a smart card-centric platform that considers public transportation trips, public utility services, e-purse micropayments and commercial value-added services Unified integration. Yujiapu smart center includes wisdom information center, wisdom operation platform and wisdom data center computer room.

(3) Progress in the construction of the starting area

With the development of various buildings, underground parking, road traffic and underground businesses in the starting area, the construction of smart city in the Yujiapu Financial District starting area has been put into use gradually with the completion of the construction. At present, we have completed the construction of smart street lamps, smart parking and other infrastructure to realize the information release and sensor functions. The strong weak electricity network has been completed and has been connected to the emergency command center to initially realize the internet of things in Smart City.

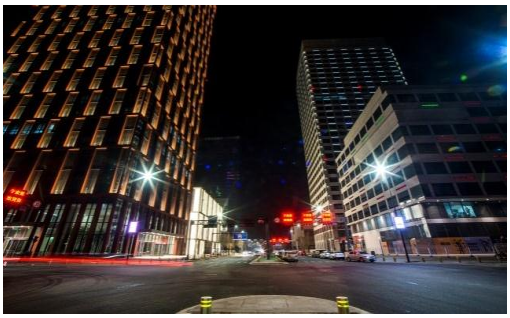


Figure 2.9.1 Intelligent street lamps and intelligent parking sharing in Yujiapu

The construction of emergency command center platform (road camera video will gather to the emergency platform by fiber-optical to realize real-time monitoring, more than 8000 have been planned and 3000 are accessed) of starting area has completed. The initial research on smart city functional requirements is carried out, communicate with city urban management to carry out the smart urban management research jointly and form a smart urban management planning.

Figure 2.9.2 Emergency Command Center in Yujiapu

# 3 Diversified Development and Management Experience in Yujiapu Financial District

## 3.1Planning Management Model in Yujiapu

In 2008, in order to make the planning and design of YuJiapu reach the international high level, the urban design of Yujiapu was collected to the world. There are eight internationally renowned enterprises have been selected for unified planning and design, such as SOM, NSRI, SYSTRA and so on.

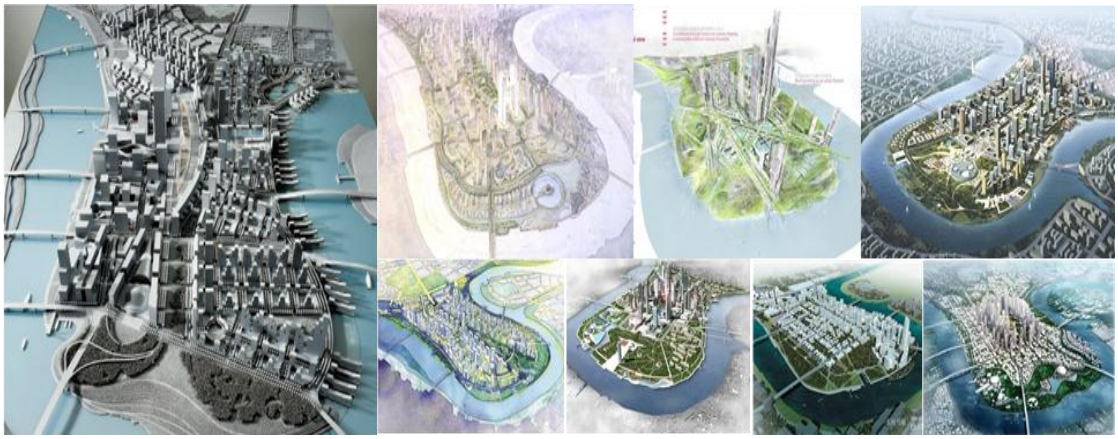

Figure 3.1 Urban Design of Yujiapu Collection

During the process of planning and construction of Yujiapu Financial District, in order to meet the social and regional trend, formulate land development and transfer plans, optimize the layout of urban space, and improve supporting facilities, and optimization of regional functions. The central business district planning and promotion work camp was established by Central Business District Administrative Committee on January 1, 2016. The leading group is a part of the central business district city construction command department; including the Construction and Transportation Bureau in Central Business District , the group, TIFI and Xincheng company etc.

The main responsibilities of the establishment of the camp are to speed up the progress of the planning and design of Yujiapu financial district, summarize the problems in the preliminary planning and construction process, integrate the future urban development trends, fully control the existing regional plans, land use, municipal facilities and low-carbon development and other aspects of multi-angle and multi-level to enhance the improvement of regional planning, enriching regional functions, with the existing building as a reference for guidance Yujiapu financial district planning and construction. Work camps carry out specific work in the following areas:

- Planning and design of urban design, regulatory detailed planning, integrated pipe network, road traffic and environment landscape of various functional sections in Yujiapu Financial District;
- Residential real estate development strategy formulation in Yujiapu Financial District, planning and design of residential development in key plots;
- The development of metro line Z4 and B1 line along the site and the surrounding plots, the planning and design of underground space, underground traffic and common ditch in Yujiapu and Tianjian Area;

- The regional land transfer plan and other specific work.

## 3.2Development Mode of Yujiapu Financial District

The development of Yujiapu Financial District is dominated by government and operated by specific company. At the beginning of planning, Tianjin Innovative Finance Investment Co., Ltd. as the regional development platform company is responsible for the overall planning, development, investment and operation management of the district. And during the building process in the starting area, a coordination mechanism was established for the government, Platform Company and developer to improve the construction level and efficiency.

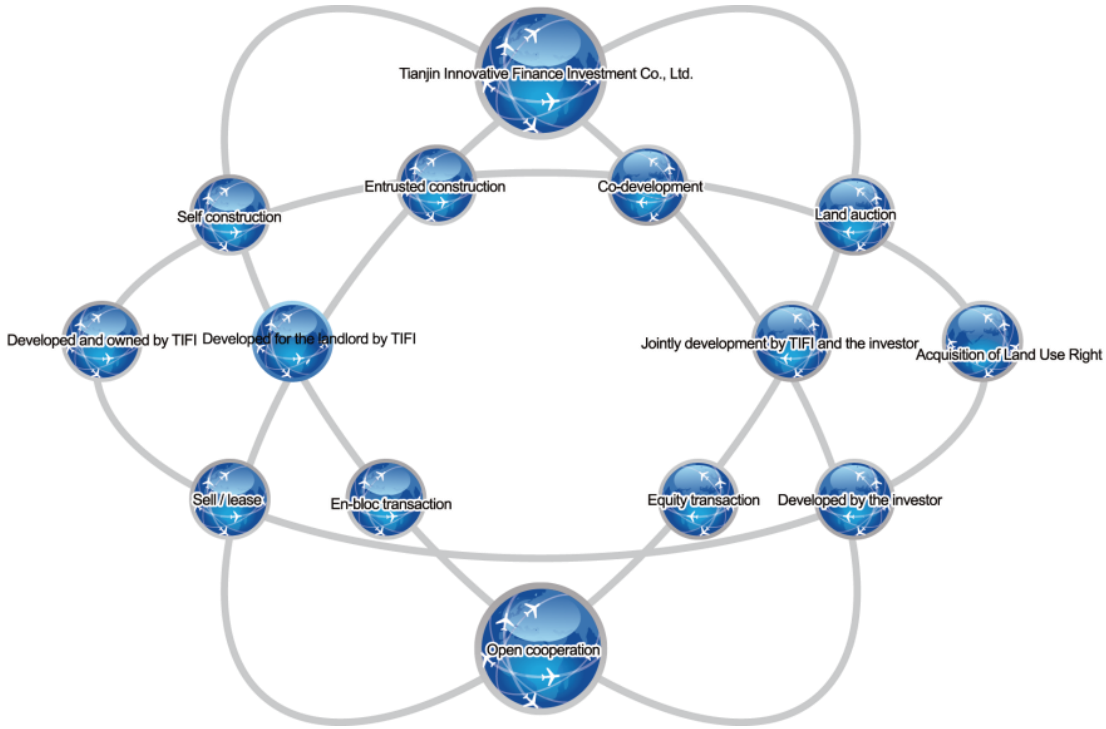


Figure 3.2 Development Mode of Yujiapu Financial District Starting Area

In the form of construction, investors can choose their own modes, including self-building, cooperative development, construction by TIFI (investors can buy back or rent for purchase in the future), purchase land developed by TIFI, and develop them by themselves.

## 3.3Project Management in Yujiapu Financial District

(1) Design Management

At the beginning of the project planning, a high-level urban design team was set up to enhance the overall planning level of Yujiapu including planning team with SOM, Nikken Sekki and MVA as the core, and the supporting of conceptual design team, construction drawing design team, underground space design team, municipal engineering design team, landscape design team and deep foundation ditch design team and other professional design team are also formed to accumulate the regional development experience, improve the level of regional planning, design and construction.

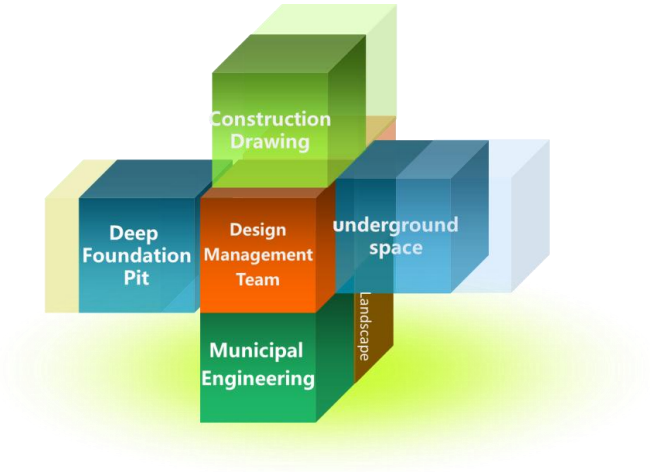


Figure 3.3 Design Management Teams

(2) Engineering Management

During the construction of the starting area, a stable design management and project management team was set up to take charge of the professional and technical output of various buildings and public infrastructure projects so as to guide and perfect the construction of various projects in the region. At the same time, with the continuous improvement of the urban planning of Yujiapu Financial District and the further development of its construction, some professional companies, such as Tianjin Innovative Finance Low Carbon Institute, Tianjin Innovative Suez Energy Investment Co., Ltd. have set up to concentrate on low carbon planning and energy management etc.

## 3.4Recommendations for the Implementation of Low Carbon Action in Yujiapu

The establishment of low-carbon town in Yujiapu needs the active participation of all parties and requires close cooperation between the government and the market. The economic driving force is an indispensable motive force for low-carbon construction. At the same time, there is a general need for public awareness and active participation by all parties. Through media campaigns, community activities and school education, the government actively promotes low-carbon development in the community so that the public understands the important role of low-carbon development in the life and environmental protection of residents. Through the forms of subsidies and fund-raising, an effective incentive mechanism for low-carbon lifestyles will be established to promote the transformation of the awareness of the development of the whole society. The following table is recommendations for Low Carbon Action in Yujiapu.

Table 3.1 Recommendations for Low Carbon Action in Yujiapu

| NO. | Recommendations | Contents |
|---|---|---|
| **Area One: Low Carbon City Management** | | |
| 1 | Develop a carbon emission action plan | Develop a work plan and a capacity building plan for the preparation of a carbon inventory. The department in charge shall be responsible for issuing the plan and invite the experts to discuss |
| 2 | Establish a mechanism to evaluate the effect of low-carbon development funds | Establish and improve feedback channels for funds use, regularly check the use of funds and compare with the original expectations |

| | | |
|---|---|---|
| 3 | Formulate regulations on green procurement | To formulate the green procurement list and procurement methods by green product directory and implement |
| 4 | Preparation of green products directory (energy saving, environmentally friendly products directory) and documents | According to the principle of energy saving, water saving, low pollution, low toxicity, renewable and recyclable, reference to the list of countries to prepare green products directory |
| 5 | Establish an information platform to disclose relevant information on low-carbon planning and management documents to the outside world | Establish information platforms such as networks, radio and newspapers, and make public the relevant information on low carbon planning and management documents; collect relevant policies, measures, projects, activities and other information on low carbon development and publish them on a regular basis |
| 6 | Establish communication feedback channels | Establish channels for public feedback on low-carbon planning and documents management through the Internet, newspapers, and administrative agencies |
| 7 | Set up city comprehensive information management center | Intelligent management and low-carbon operation for buildings' energy, transportation, environment, municipal facilities, security in the area |
| 8 | Low-carbon life and cultural publicity | Through the construction of garbage classification and reduction pilot, as well as various publicity methods to promote the improvement of residents' awareness of garbage classification and reduction |
| **Area Two: Low Carbon Economy** | | |
| 1 | Promote the signing of voluntary emission reduction agreements in the service sector | Set agreement template, organize promotional activities for all enterprises to prompt service companies to sign voluntary emission reduction agreements |
| 2 | Encourage participation in carbon trading | Establish a carbon risk investment mechanism to foster a trading system for low-carbon financial markets and build a diversified low-carbon investment and financing channel |
| 3 | Establish a carbon emission certification system | To verify the carbon emission in the whole process of project construction and commissioning by a third-party carbon accounting unit and to determine the carbon emission baseline of the project based on the settled enterprises and carbon emission data |
| 4 | Formulate incentive policies to encourage the registration and establishment of low-carbon investment technology companies | Formulate incentive policies (both material and non-material) that encourage the registration and establishment of low carbon investment technology companies |
| **Area Three: Low Carbon Energy** | | |
| 1 | Establish energy management monitoring platform | Promptly publicize the results of energy conservation monitoring |
| 2 | Formulate incentive policies to encourage the registration and establishment of contractual energy management service enterprises | Formulate incentive policies (both material and non-material) that encourage the registration and establishment of low carbon investment technology companies |
| 3 | Establish a regional energy management system | Establish a smart energy management system with systematic early warning and expert advice to manage the energy supply and consumption and |

| | | |
|---|---|---|
| | | provide the data foundation and support for the carbon emission trading platform |
| **Area Four: Low Carbon Building** | | |
| 1 | Draw up the statistics and analysis report on building energy consumption periodically | Establish emission monitoring, statistical system, long-term feedback and regulatory mechanism. Prepare emission inventories based on statistics. |
| 2 | Preparation of urban new district building energy efficiency planning | Preparation of urban new district building energy use planning, planning, action guidelines |
| 3 | Establish a low-carbon construction supervision system | Low-carbon knowledge training for construction, construction and supervision personnel in the district; Establishment of full-time low-carbon supervision engineer; Establishment of low-carbon construction management system and improvement of low-carbon construction plan |
| 4 | Construction of "zero carbon emissions" pilot project Construction | Build a "zero carbon emission" pilot project for low-carbon display, promotion and experience |
| **Area Five: Low Carbon Transportation** | | |
| 1 | Start the compilation of carbon emissions statistics for the transport sector | Establish emission monitoring, statistical system, long-term feedback and regulatory mechanism in the transport sector. Prepare emission inventories based on statistics. |
| 2 | Build smart transportation system | Establish a regional road traffic information collection system; establish a bus intelligent altitude command platform; improve the taxi intelligent dispatching platform; establish a parking management and guidance system in the area |
| 3 | Develop bus priority development programs | The responsible department shall take the lead in formulating the views of bus priority development |
| 4 | Build non-motorized traffic system | Set up a convenient bike rental station, and establish bicycle rental management system. |

# 4 Low Carbon Development and Management Strategy in Yujiapu Financial District

As the First APEC Low Carbon Model Town, Yujiapu made innovations in its management strategy. It established a comprehensive inventory control program for the construction of greenhouse and compiled the internal inspection guidelines for the carbon emissions of buildings in Yujiapu. At the same time, the energy management system and the proposal for the implementation of the low carbon operation in Yujiapu were proposed.

## 4.1 Analysis on Construction Carbon Emission in Yujiapu Starting Area

### 4.1.1Calculation of Construction Carbon Emission

(1) Calculating boundary

According to the application plan of project research and the information needs of decision-makers, it is the first step and the most crucial task to determine the project's evaluation objectives and define the boundary of the project according to the established evaluation objectives, which will directly affect the entire evaluation process and the accuracy of the final result. The entire construction project in accordance with the time sequence can be divided into conceptual design, planning design, project implementation phase and operation and maintenance phase. The scope of carbon emission measurement is defined as the implementation phase of the project.

The project implementation phase is the construction phase. The main task of this phase is to adopt the appropriate construction technology to turn the design on the drawings into a physical building. The construction unit is responsible for the construction organization and management of the construction process. Therefore, electricity, water, diesel, gasoline and other energy consumption in the construction, office and living areas, as well as the choice of construction materials, the use of basic determine the amount of carbon emissions during the construction phase. By collecting the data of the construction in the starting area of Yujiapu and quantifying the carbon emission in the construction phase of Yujiapu starting area, it provides a guideline for the implementation of the low-carbon technology during the construction of Yujiapu's follow-up building. Therefore, in the implementation phase of the construction project, the main executive body is the construction unit. The boundary of carbon emissions in the construction period of Yujiapu starting area is shown in Figure 4.1.1 below. The construction phase of Yujiapu starting area mainly includes various activities such as earthwork, foundation and foundation engineering, main structure, building decoration and construction, site clearing, office work and living.

The specific scope of the carbon emission calculation boundary in the construction phase of the Yujiapu starting area is as follows: (1) The construction area mainly includes the power consumption of all construction machinery and equipment in Yujiapu starting area, the consumption of energy such as diesel and gasoline, and carbon emission. (2) Office area, including the air-conditioning, lighting, office equipment and other power consumption, water consumption, etc. in Yujiapu starting area. (3) Living area, including the air-conditioning, lighting, canteen etc., such as electricity consumption, water consumption and consumption of liquefied petroleum gas.

For the moment, we will not consider other environmental impacts. Only for greenhouse gas in construction stage, carbon emissions in construction area of Yujiapu starting area, including carbon emissions in construction area, carbon emissions in office area and carbon

emissions in living area, are calculated. The construction units for construction materials entering the statistics is mainly aimed at the production license, product certificate of quality, guarantee of strict record for building materials, transportation distance, transportation, transport vehicle type no records, construction materials of carbon emissions is calculated according to the life cycle of carbon materials for emissions, so carbon emissions in Yujiapu starting area of construction stage does not include emissions from building materials.

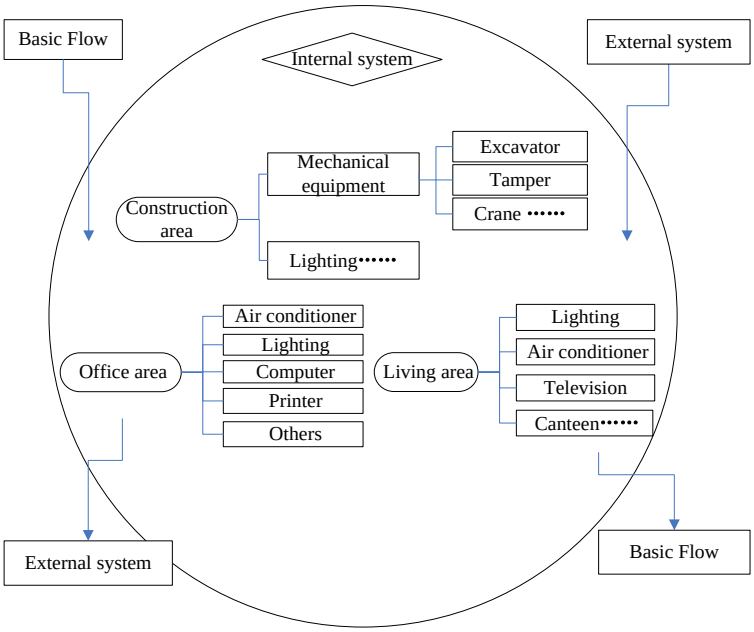


Figure 4.1.1The Boundary of Carbon Emissions in the Construction Period of Yujiapu Starting Area

(2) Calculation methods and ideas

The four methods of integrated construction carbon emission measurement, the field measurement method is time-consuming and labor-intensive, the process estimation method is not mature, and the input-output method cannot reflect the difference between using the new technology. Select the energy consumption statistics in the construction final accounts of Yujiapu starting area and calculate the carbon emission coefficient of each energy source by the IPCC greenhouse gas method, so that the construction carbon emissions can be obtained more directly and accurately. The detailed calculation steps are as follows:

- Count the electricity consumption, water consumption, diesel consumption and gasoline consumption in the construction area of Yujiapu starting area and collect the electricity consumption, water consumption, LPG consumption, diesel consumption and gasoline consumption in office area and living area with construction data management personnel in each plot in Yujiapu starting area.
- According to the sub-projects of construction projects in the construction area of Yujiapu starting area, find out the types, quantity, class size, power consumption and fossil energy consumption of construction machinery in statistical final accounts;
- Statistics of the main construction materials used in the construction stage;
- With reference to the *General Rules for Comprehensive Energy Consumption*, IPCC data and calculation methods, the $CO_2$ emission factors of various fossil fuels, electric energy and various construction materials are found and calculated based on the situation in Yujiapu starting area.

• Calculate the $CO_2$ emissions from energy consumption in construction area, office area and living area, $CO_2$ emissions from various construction machines and $CO_2$ emissions from various construction materials.

• Calculate the total amount of carbon emissions in the construction phase of Yujiapu starting area and the carbon emissions per unit of construction area;

• Analysis the calculation results based on the specific situation of plots in Yujiapu starting area.

Figure 4.1.2 Construction Site of Yujiapu High Speed Rail Way Station

(3) Calculation of carbon emission in construction process

The projects under construction of Yujiapu starting area phase one are “9+3” altogether 12 plots. We have collected the carbon emissions from the construction area, office area, living area and mechanical equipment of 7 plots in Yujiapu starting area. The results are as follows.

Table 4.1.1 Carbon Emission Calculation of 7 Plots in Yujiapu Starting Area

| Plot | $CO_2$ generated by electrical energy consumption (t) | The $CO_2$ produced by the use of water (t) | $CO_2$ produced by diesel fuel consumption (t) | $CO_2$ produced by gasoline consumption (t) | $CO_2$ produced by LPG consumption (t) | Total $CO_2$ emissions (t) | Floor area ($m^2$) | $CO_2$ emissions per unit building area ($kg/m^2$) |
|---|---|---|---|---|---|---|---|---|
| 03-04 | 2754.14 | 27.58 | 12.48 | 0.00 | 0.00 | 2794.20 | 193000 | 14.48 |
| 03-18 | 1473.34 | 13.82 | 153.75 | 67.35 | 47.62 | 1755.89 | 110300 | 15.92 |
| 03-20 | 2021.72 | 3.53 | 291.78 | 10.39 | 0.00 | 2327.42 | 71500 | 32.55 |
| 03-21 | 1914.43 | 10.90 | 370.06 | 18.45 | 46.20 | 2360.04 | 120473 | 19.59 |
| 03-22 | 5880.70 | 1.21 | 48.36 | 0.00 | 15.28 | 5945.56 | 199800 | 29.76 |
| 03-25 | 2668.53 | 2.74 | 566.74 | 306.48 | 22.43 | 3566.92 | 113611 | 31.40 |
| 03-26 | 2347.54 | 4.42 | 117.66 | 0.89 | 15.27 | 2485.77 | 156896 | 15.84 |
| Average | 2722.91 | 9.17 | 222.98 | 57.65 | 20.97 | 3033.69 | —— | 21.99 |

* Note: the gasoline consumption data of some plots in the table is 0, because the data of the gasoline use equipment are all rented without statistics, and the data of LPG consumption is 0 because there is no living area in the plot.

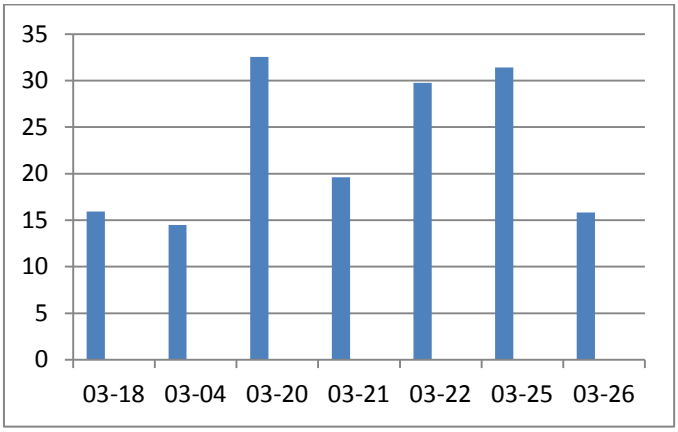


Figure 4.1.3 $CO_2$ emissions per unit building area of 7 plots in Yujiapu starting area

According to the above calculation, the average carbon emission of the unit building area of 7 plots in Yujiapu starting area is 21.99kg/$m^2$.

In addition, in Yujiapu starting area, the proportion of $CO_2$ generated by energy consumption in the total emission is the largest, as shown in the figure below, in which $CO_2$ from electricity consumption accounts for more than 80% of total carbon emissions, and $CO_2$ from electricity consumption and diesel consumption accounts for more than 90% of the total carbon emissions.

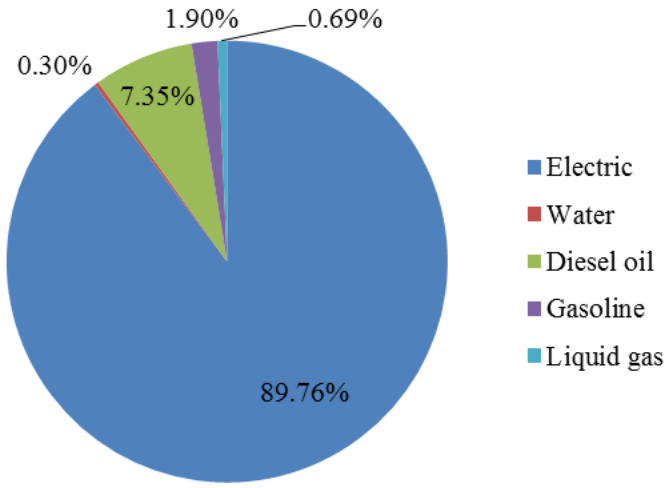


Figure 4.1.4 $CO_2$ ratio diagram of each energy consumption in 7 plots of Yujiapu starting area

(4) Carbon emission calculation of building martials

In the calculation range, it has been explained that due to the lack of relevant records on the transportation distance, transportation mode and vehicle type of the building material management personnel, the carbon emissions from building materials transportation cannot be calculated. According to the data collected from construction materials, the carbon emission calculation of reinforced concrete and concrete building materials used in the construction of 7 plots in Yujiapu starting area is calculated from the life cycle perspective. The 6 plots are calculated and the results are as follows.

Table 4.12 Carbon emission calculation results of steel and concrete of 6 plots in Yujiapu starting area

| Plot | The total amount of $CO_2$ produced by steel and concrete (t) | Floor area ($m^2$) | Carbon emissions of materials per unit building area($kg/m^2$) |
|---|---|---|---|
| 03-18 | 47968.20 | 110300 | 434.89 |
| 03-04 | 73016.30 | 193000 | 378.32 |
| 03-20 | 43945.25 | 71500 | 614.62 |
| 03-21 | 89400.00 | 120473 | 742.07 |
| 03-22 | 74471.66 | 199800 | 372.73 |
| 03-25 | 54029.33 | 113611 | 475.56 |
| Average | 63805.12 | —— | 503.03 |

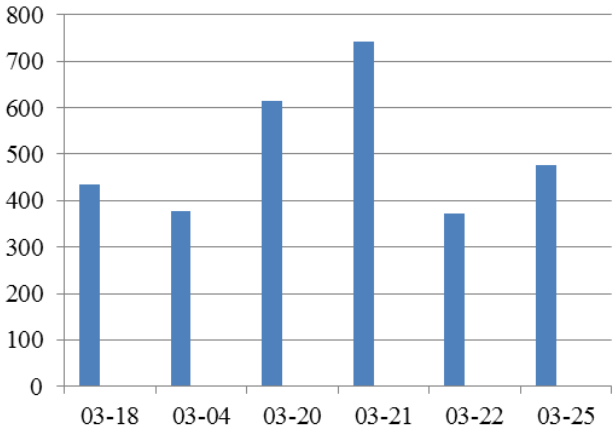


Figure 4.1.5 carbon emissions of materials per unit building area of 6 plots in Yujiapu starting area

**4.1.2 Comparative analysis on carbon emission in construction**

Due to the small amount of data collected from construction carbon emissions statistics, the reasonable screening of 19 common public buildings with reinforced concrete as a sample for statistical analysis during the construction phase of carbon emissions is compared with that of Yujiapu construction.

Table 4.1.3 Sample construction carbon emissions statistics table

| Project | Floor Area ($m^2$) | Total amount of carbon emissions in construction (kg) | Carbon emissions per unit building area ($kg/m^2$) |
|---|---|---|---|
| No.1 | 4980.50 | 131352.64 | 26.37 |
| No.2 | 5021.12 | 127436.03 | 25.38 |
| No.3 | 4850.63 | 86486.73 | 17.83 |
| No.4 | 6011.25 | 159418.35 | 26.52 |
| No.5 | 3954.98 | 101049.74 | 25.55 |
| No.6 | 4455.60 | 70977.71 | 15.93 |
| No.7 | 5823.74 | 163355.91 | 28.05 |

| | | | |
|---|---|---|---|
| No.8 | 20800.00 | 474030.00 | 22.79 |
| No.9 | 3326.84 | 66071.04 | 19.86 |
| No.10 | 2966.30 | 72140.42 | 24.32 |
| No.11 | 5010.23 | 103912.17 | 20.74 |
| No.12 | 4591.15 | 97424.20 | 21.22 |
| No.13 | 3362.88 | 79498.48 | 23.64 |
| No.14 | 2100.30 | 39128.59 | 18.63 |
| No.15 | 1997.52 | 49957.98 | 16.01 |
| No.16 | 14121.00 | 380702.16 | 29.96 |
| No.17 | 5471.26 | 142854.60 | 18.11 |
| No.18 | 3884.25 | 114002.74 | 29.35 |
| No.19 | 125631.50 | 4789.21 | 26.23 |
| Average | —— | 129715.19 | 22.97 |

Through the data analysis, it is concluded that the average carbon emission of the sample building is about 22.97kg/$m^2$. The calculated results of 7 plots in Yujiapu starting area are 4.25% less than the average.

### 4.1.3 Measures and Suggestions on Low Carbon Construction Management

Low-carbon construction refers to during the construction phase, low carbon planning, low carbon design should be strictly implanted. Under the precondition of ensuring the safety and quality of the project, through the establishment of the management system and management system, effective low-carbon technical measures should be taken to fully implement policies on energy conservation, emission reduction and clean development, maximize resources conservation, reduce energy consumption and reduce adverse effects of construction activities on carbon emissions.

Low carbon construction is an important stage in the whole life cycle of the building. In the implementation of low carbon construction, the overall plan should be optimized. In the planning and design stage, the overall requirements of low carbon construction should be fully considered, and the basic conditions for low carbon construction should be provided. We should control the construction planning, material purchase, site construction and project acceptance, and strengthen the management and supervision of the whole construction process.

Figure 4.1.6 Construction Scene of Yujiapu Starting Area

In the construction of Yujiapu Financial District, low carbon construction is fully implemented. Under the premise of ensuring the basic requirements of quality and safety, implement the laws and regulations and related standards and norms. Based on Tianjin and

industry-related technologies economic policy, establish and improve a low-carbon construction supervision system that is matched with the construction of "low carbon model town" in Yujiapu Financial District through scientific management and technological progress and according to local conditions, and form a constraint mechanism on energy consumption and greenhouse gas emissions during the construction phase, Through the formulation and implementation of incentive policies such as emission reductions (simulation) transactions, the low carbon construction will be standardized to save resources to the maximum and reduce the impact of construction on greenhouse gas emissions to achieve energy saving, land saving, water saving and material saving, environmental protection and protection of the global climate.

(1) Special measures for low carbon construction

- Application of low carbon construction technology

| No. | Application of low carbon construction technology |
|---|---|
| 1 | Develop energy saving, emission reduction and clean development technologies suitable for low carbon construction, restrict or eliminate backward construction programs, encourage the development of low carbon construction technology, and promote the innovation of low carbon construction technology. |
| 2 | Vigorously develop on-site monitoring technology, low noise construction technology, on-site environmental parameter detection technology, self-compacting concrete construction technology, fresh water concrete construction technology, building solid waste recycling products in the wall materials in the application of technology, new templates and scaffolding technology research and application. |
| 3 | Strengthen the application of information technology, such as the low-carbon construction of the virtual reality technology, automatic construction of three-dimensional model of construction statistics, low-carbon construction design database construction and application systems, digital sites, e-commerce based construction materials, equipment and logistics management system Wait. Through the application of information technology, precision planning, design, well-built and optimized integration, to achieve and enhance the low-carbon construction of the indicators. |

- Low carbon management- The house of the builder

The property management department for the house of the builder shall formulate and implement the management system of energy saving, water saving, material saving and afforestation, and shall separate household income, water resources, electricity, gas and heat supply, classify the measurement and charging, and implement resource management incentives mechanism, so that the economic benefits of the property and the "house of building" can be directly linked with the efficiency of water consumption, etc.

Figure 4.1.7 The House of the Builder

- Carry out low carbon knowledge training

The training of low carbon knowledge is carried out regularly, and the training is divided into general knowledge training, special knowledge training and post knowledge training. Among them, general knowledge training is the basic training, mainly including low carbon common knowledge and *Tianjin's low carbon construction management method in Yujiapu Financial District*. All construction and supervision personnel in Yujiapu Financial District are required to participate in training and testing of low carbon general knowledge.

- Special supervision and management

The regulatory unit has a full-time low carbon regulatory engineer, and is fully responsible for the supervision of low carbon construction. The duties and powers of a low carbon regulatory engineer shall be stipulated in the written authorization of the general supervision engineer. Low carbon supervision engineers must be trained in low carbon post knowledge. After the examination is qualified, they can be laid off.

(2) Low carbon construction management system

The low carbon construction management system mainly includes four aspects, namely, organization management, planning management, implementation management and evaluation management.

- Organization management

Establish a low-carbon construction management system, and develop the appropriate management system and objectives. The project manager is the first person responsible for the low carbon construction, and is responsible for the implementation of the low carbon construction and the realization of the target, and designate low carbon construction managers and supervisors.

- Planning management

| NO. | Planning management measures |
|---|---|
| 1 | Low carbon construction plan was compiled before construction. The low carbon construction scheme meets the relevant rules, regulations, standards and codes of the current green construction regulations, standards and regulations issued by the state and Tianjin. |
| 2 | The construction scheme of the main structure should be optimized with advanced technical level and environmental effect. For the same construction process, there are a number of alternatives, as far as possible to select the energy-saving emission reduction and clean development plan. Partial construction should actively adopt the currently emerging construction technologies with significant energy saving and environmental protection effects, such as straight thread connection mode and new template form. |
| 3 | In accordance with its own engineering characteristics, the construction project can actively draw on the industrial production model. Try to transfer all or part of the construction work that was originally carried out on the scene to the centralized processing farm or factory in the financial district, and only a simple assembly is carried out on the scene. |

- Implementation management

| NO. | Implementation management measure |
|---|---|
| 1 | Low carbon construction should carry out dynamic management in the whole construction process, and strengthen management and supervision in all stages such as construction planning, construction preparation, material procurement, on-site construction, and engineering acceptance and so on. |

| | |
|---|---|
| 2 | According to the characteristics of the project, we should publicize the work of low carbon application and create the atmosphere of low carbon construction. |
| 3 | Regular training of low carbon construction knowledge for workers and workers to enhance workers' awareness of low carbon construction. |

- Evaluation Management

| NO. | Evaluation management measure |
|---|---|
| 1 | According to the specific requirements of this management approach, combined with the engineering characteristics, we evaluate the effect of low carbon construction and the new technologies, equipment, materials and processes adopted. |
| 2 | An assessment team is set up to conduct a comprehensive assessment of the low carbon construction plan, the implementation process and the completion of the project. |

(3) Management of Low Carbon Construction Material Resources

| NO. | Material saving measure |
|---|---|
| 1 | When the drawings are to be examined, the relevant contents of materials utilization and materials resources utilization shall be reviewed, and the material loss rate shall be reduced by 30% from the quota loss rate. |
| 2 | We should optimize the construction plan, select low carbon and green materials, actively promote new materials and technologies, promote the rational use of materials, and save the consumption of actual construction materials. |
| 3 | According to the progress of construction, material turnover time, inventory and so on, the purchase plan is formulated, and the purchase quantity, entry time and batches are reasonably determined, so as to reduce inventory and avoid overstocking, resulting in backlog or waste. |
| 4 | In accordance with the construction budget, implementation limits, strict control of material consumption. |
| 5 | The construction site should establish a list of recyclable reusable materials, formulate and implement the recovery management methods of recycled waste, and improve the utilization rate of waste. The solid wastes generated from building construction, demolition of old buildings and site cleaning shall be classified, and the recyclable materials and recyclable materials can be recycled and reused. |
| 6 | The recycling performance of the material is considered in the material selection of the architectural design. In the case of safe and nonpolluting environment, recyclable materials are used as much as possible. Recirculating material, which is a material that cannot be reused, can form another material by changing the form of the material. |
| 7 | On the premise of guaranteeing the performance, we should use the building material which is made of waste as the raw material as far as possible. |
| 8 | According to the investigation of the construction status of the site, the possibility and economy of the existing construction and facilities reutilization are analyzed, and the duration is reasonably arranged. Using the proposed roads and buildings to improve the reutilization rate of resources. |
| 9 | Temporary facilities (office and living space, water supply and drainage, lighting, fire-fighting pipelines and fire-fighting equipment) required for the construction of the project should adopt removable and recyclable materials and list the recycling and reuse measures in the relevant special programs. |

| | |
|---|---|
| 10 | The site materials are stacked in order. The storage environment is suitable and the measures are appropriate. The safekeeping system is sound and the responsibility is carried out. Material handling and temporary storage are carried out in accordance with the material storage requirements, so as to avoid waste due to the unreasonable storage conditions on the site. |
| 11 | To maintain the turnover material, maintain its quality and prolong its service life. Take technical and management steps to increase the turnover of templates, scaffolding, etc. |
| 12 | The material transport tools are suitable, the handling methods are appropriate, and the damage and spillover are prevented. Near unload on the basis of site layout, avoid and reduce two handling. |
| 13 | Optimization of installation, pre embedding, pipeline route and other schemes. |
| 14 | We should try to use local materials, the production of construction site within 500 kilometers of building materials. |

(4) Low carbon construction water resources management

- Improve the efficiency of water use

| NO. | Improve the efficiency of water use |
|---|---|
| 1 | In the construction, the advanced water saving construction technology is adopted. |
| 2 | It is not appropriate to use municipal tap water for pouring and sprinkling the pavement in the construction site. The effective water saving measures should be taken in the field of mixing water and maintenance water, and no measures are strictly prohibited to water the concrete. |
| 3 | The water supply pipe network in the construction site should be designed and arranged according to the water consumption. The pipe diameter is reasonable, the pipeline is simple, and the effective measures are taken to reduce the leakage of the pipe network and the water use equipment. |
| 4 | The water circulating equipment must be set up for the field equipment and vehicles for washing water. |
| 5 | In the construction site, a collection and treatment system for reusing water is set up to make water resources be recycled by the cascade. |
| 6 | Water measurement management should be carried out in the construction project, and the water consumption in the construction phase should be strictly controlled. At the construction site, the quota of water for life and engineering water is determined respectively, and the management is measured separately. |
| 7 | The water consumption should be measured separately for the different projects, different sections and different subcontracting areas. |
| 8 | Concrete mixing stations, such as water concentrated area and process points for special measurement assessment. Waste water recycling facilities should be set up to recycle waste water after recycling. |

- Non-traditional Water Use

| NO. | Non-traditional water use |
|---|---|
| 1 | The water of machine, equipment, vehicle flushing, spraying Road, greening and irrigation gives priority to the use of non-traditional water sources, try not to use municipal tap water. |
| 2 | The construction site should set up a rainwater collection and utilization system to fully collect natural precipitation for the suitable parts of construction and life. |

(5) Energy management of low carbon construction

- Energy saving measure

| NO. | Energy saving measure |
|---|---|
| 1 | The energy saving measures should be worked out at the construction site, and the energy utilization rate of the construction should be increased. A reasonable construction energy consumption index should be worked out, and a special consumption reduction measures must be made for the process of large energy consumption. |
| 2 | The power consumption of the transformer should be estimated correctly and the capacity of the transformer should be selected. |
| 3 | We should give priority to the use of energy saving, efficient and environmentally friendly construction equipment and equipment recommended by the state and industry, such as the use of energy saving construction equipment with frequency conversion technology. New technology and new equipment should be adopted, and the electric equipment should be updated continuously. |
| 4 | The construction project should implement the electricity metering management, and strictly control the electricity consumption in the construction stage. |
| 5 | In order to reduce the number of machines in the operation area and make full use of the common machine resources in the adjacent area, we should arrange the construction sequence and working face rationally in the construction organization design. |
| 6 | Energy saving design should be carried out for the temporary construction of electricity. |
| 7 | Make full use of renewable energy such as solar energy. |

- / Equipment and Machinery

| NO. | Equipment and machinery |
|---|---|
| 1 | Establish a management system for timely maintenance, warranty and inspection of construction machinery and equipment, carry out electricity consumption and oil metering, improve equipment archives, and timely maintain so that mechanical equipment can maintain low consumption and high efficiency. |
| 2 | Construction machinery should choose energy-efficient motors; choose power and load matching construction machinery and equipment, so as to avoid high power construction machinery and equipment running at low load for a long time. Electricity saving mechanical equipment can be used in mechanical and electrical installation. |
| 3 | Arrange the process reasonably, improve the use rate and full load rate of all kinds of machinery, and reduce the unit energy consumption of all kinds of equipment. |

- Temporary facilities for production, living and office

| NO. | Temporary facilities for production, living and office |
|---|---|
| 1 | By using the natural conditions of the site, we can reasonably design the shape, orientation, spacing and window wall area ratio of the temporary facilities for production, living and office, so that they can get good sunshine, ventilation and day lighting. In winter, sunshine is used and the leading wind is avoided, and natural ventilation is used in summer. |

| | |
|---|---|
| 2 | Temporary facilities should be made of composite walls and roofs with highly efficient thermal insulation materials, doors and windows with good sealing and thermal insulation properties, so as to reduce the use time and energy consumption of air conditioning in summer, heating equipment in winter. |
| 3 | The reasonable allocation of heating, air conditioning, fan quantity, the provisions of the use of time, the implementation of sub - time use to save electricity. |
| 4 | We should strengthen the management of the system and save the living electricity. |

- Electricity and lighting for construction

| NO. | Electricity and lighting for construction |
|---|---|
| 1 | The qualified wire and cable should be selected, and the cable of broken core and broken strand should be strictly prohibited. |
| 2 | The temporary electricity consumption must be strictly according to the standards, specifications and regulations. The wiring terminals should be connected to the qualified terminals and the wires must not be directly wound. The copper aluminum connection must be connected with the copper aluminum transition joint. |
| 3 | The power supply for the construction operation team must be applied to the site power supply management department in writing (indicating the capacity and load property). After the approval of the site's power supply management department, the power shall be overlapped according to the specified line and wiring. |
| 4 | The temporary electricity use system on the site should be set up. The workers should turn off the lights at any time. They should be strictly forbidden to use electric furnaces for heating and cooking, and the use of soil electric mattresses is strictly prohibited. |
| 5 | When the construction is completed at night, most of the lighting in the construction area is closed in time, and only the surrounding roads are left for the night inspection. |
| 6 | In general lighting for high lights in construction luminaries, high pressure sodium lamps, metal halide lamps or ballast high-pressure fluorescent mercury lamps should be selected. Besides special circumstances, tubular halogen tungsten lamps and high power ordinary incandescent lamps should not be used. Fluorescent lamps are used for lighting in lower hanger places, and incandescent lamps should not be used. |

(6) Low carbon construction site management

| NO. | Low carbon construction site management |
|---|---|
| 1 | The general layout of the construction should be scientific and reasonable, and the construction service should be made full use of the original buildings, structures, roads and pipelines. |
| 2 | The layout of mixing station, warehouse, processing plant, operation shed and material yard should be close to existing traffic lines or temporary or temporary traffic lines to be built, so as to shorten transportation distance. |
| 3 | Temporary office and living rooms should adopt standard assembly structure, such as economical, beautiful, small footprint, less influence on the surrounding geomorphologic environment, and suitable for dynamic adjustment of construction layout. The living area and the production area should be arranged separately and the standard separation facilities should be set up. |

| | |
|---|---|
| 4 | The wall of the construction site can be prefabricated with light steel structure enclosed continuous enclosure to reduce construction waste and protect the land. |
| 5 | The construction site road is arranged according to the principle of combination of the permanent road and the temporary road. In the construction site, a circular path is formed to reduce the occupancy of the road. |
| 6 | Temporary facilities layout should pay attention to the combination of distance (the current and the next project), and strive to reduce and avoid a large number of temporary demolition of buildings and site relocation. |

(7) Low carbon construction waste management

| NO. | Low-carbon construction waste management |
|---|---|
| 1 | The construction waste reduction and resource planning should be formulated to reduce the production of solid waste. After the completion of the project, all solid waste produced in the construction must be cleared up. |
| 2 | Strengthen the recycling of construction waste. For rubble and earthwork garbage, the reutilization rate can be improved by means of foundation landfill and pavement. |

## 4.2 Discussion on the Carbon Trading Model in Yujiapu Starting Area

The calculation of carbon emissions in the construction process of Yujiapu Financial District is carried out, and the quantitative results are analyzed. It is necessary to explore the carbon emission trading mode in Yujiapu starting area, laying the foundation for the management and control of carbon emissions in the whole area. At the same time, the China Development and Reform Commission issued the *Notice on the Implementation of the* China *Carbon Emission Trading Market Construction and Related Work Arrangements by China Development and Reform Commission*([2015]1024) in May 2016, which asked the local authorities to effectively enhance the understanding of the urgency and importance of the establishment of a China carbon emissions trading market, to promote the local the department in charge of the carbon emissions trading market construction. In accordance with the unified arrangements and requirements, some preparatory works were done to ensure the smooth start of China carbon emission trading market. Taking Yujiapu starting area as a pilot area for carbon emissions trading, we first try to summarize the experience and make necessary preparations for trading in the Tianjin emissions trading exchange in the future.

### 4.2.1 The Framework of Carbon Trading Model of Buildings in the Starting Area

The coverage rate of green buildings in Yujiapu starting area is 100%, and that of green buildings above the two-star level is about 70%, which indicates that a relatively high requirement has been set for building energy consumption in the area itself. Based on the research conducted in the previous section, we take Yujiapu starting as an example to discuss the carbon trading model in the region.

First, the internal trading platform should be established by the competent authorities in the area, and Tianjin Innovative Finance Investment Co., Ltd. should give some supporting support to the establishment of the platform. After the completion of the platform, each block should register the carbon emissions trading on the platform and verify the carbon emissions by the third party certification bodies.

The quota allocation in the area is carried out through the platform. According to the quotas benchmark, the excess part can be traded, the use of transactions to obtain income subsidies for energy-saving service companies to carry out energy saving transformation, by

maximizing the energy-saving buildings to achieve greater energy savings. The green star distribution is shown in Figure 4.2.1.


Figure 4.2.1 Green Star Distribution of 12 Buildings in Yujiapu Starting Area

The carbon trading model in Yujiapu starting area is the internal trading mode of 12 buildings in the starting area. First, the internal trading platform should be established by the competent authorities in the area, and Tianjin Innovative Finance Investment Co., Ltd. should give some supporting support to the establishment of the platform. After the completion of the platform, each block should register the carbon emissions trading on the platform and verify the carbon emissions by the third party certification bodies. The quota allocation in the area is carried out through the platform. According to the quotas benchmark, the excess part can be traded, the use of transactions to obtain income subsidies for energy-saving service companies to carry out energy-saving transformation. It can not only achieve greater energy saving benefits by maximizing building energy efficiency, but also indirectly achieve low carbon energy management of buildings through the economic means of internal transactions.

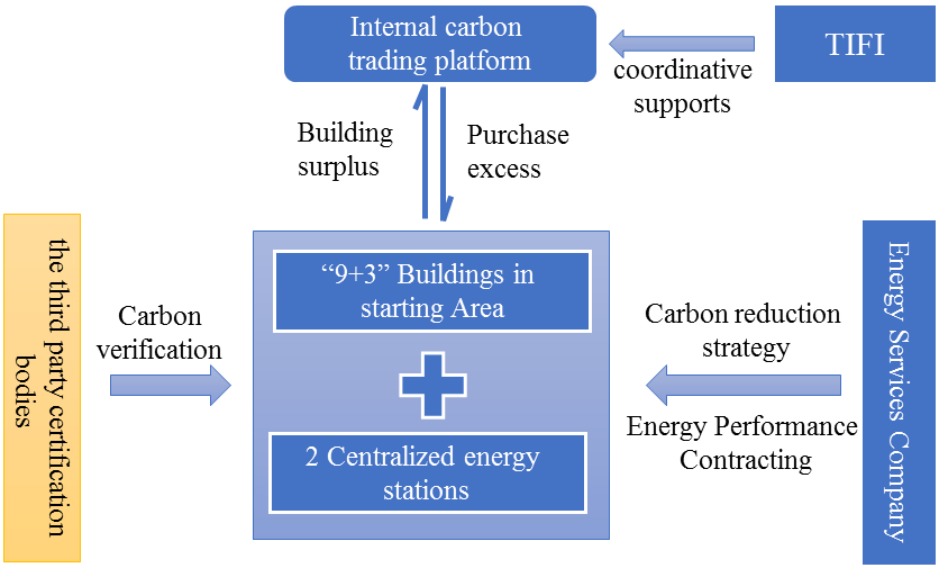


Figure 4.2.2 Trading Model of Buildings in the Starting Area

### 4.2.2Discussion on Trading Mechanism in Starting Area

(1) Initial allocation of emission quotas

Carbon emission of buildings should be granted according to the property rights of different types of buildings, owners, users and building area to determine the distribution of quotas. The allocation of initial emission rights will affect the allocation efficiency of the market. The design of a reasonable initial emission allocation scheme is the core of the emission trading. The allocation of initial quotas to consider the fairness and efficiency should be used in the construction sector, energy statistics as a benchmark. In the initial stage of China's carbon emissions trading market trial, the initial quota allocation should be free. The allocation standard should be widely solicited from all walks of life, especially the owners of buildings.

(2) Monitoring, reporting and verification of carbon emissions

The scope of carbon emissions of buildings includes direct and indirect emissions. The establishment of a carbon trading mechanism for the construction sector requires clear norms and requirements for monitoring, reporting and verification of carbon emissions for facilities. It is necessary to verify that relevant third-party reports are verified by professional third parties, and submit the verified information to the regulatory body. At the same time, we need to improve the basic conditions for monitoring, reporting and verification, including related personnel training and institution building. The buildings to be incorporated should be reported to TIFI Company for the next year's annual carbon emission monitoring plan by November 30 of each year and the monitoring should be conducted strictly in accordance with the monitoring plan. Carbon emission monitoring plan should identify sources, monitoring methods, monitoring frequency and related responsible person content. Significant changes in the actual monitoring of carbon emissions, should promptly report to the TIFI Company.

Establish a carbon emission verification system. The third party verification authority has the right to request relevant information in the building, accept on-site verification and cooperate with other verification work, check the annual emission status of the building and issue a verification report.

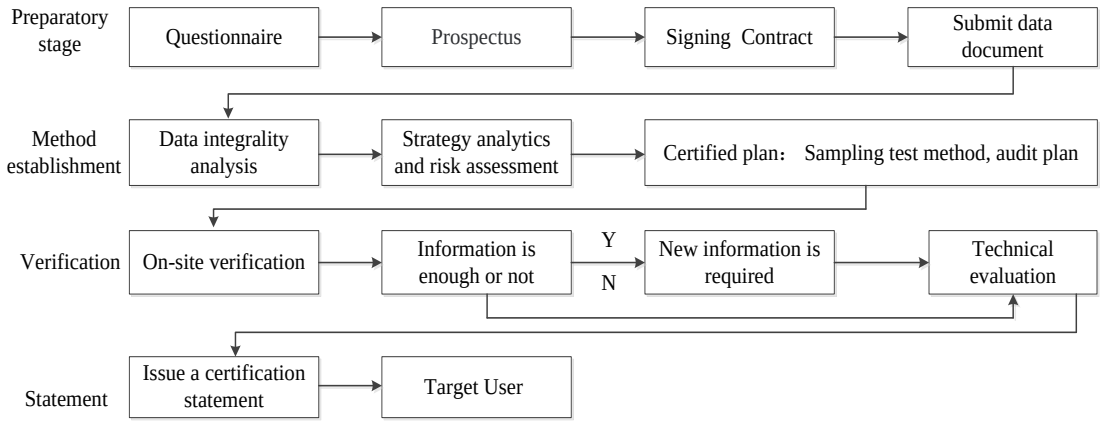


Figure 4.2.3 Certification Process of Third Party

Based on the verification report issued by the third party verification agency, TIFI Company audited the annual carbon emissions of buildings included and notified the results of the validation into the buildings as the final conclusion of TIFI Company's inclusion in the annual carbon emissions of buildings.

(3) Compliance mechanism

Compliance is a rule that covers the entity's compliance with its carbon emissions compliance obligations and the consequences of the penalties that will be faced in fulfilling a

compliance obligation. Implementation of the compliance mechanism requires legal system to protect. In China, the basic law of emission trading is lack currently. The construction of carbon emissions trading to be integrated into the construction field, especially in the field of energy saving law, administrative resources, local institutional arrangements, including fines, take project approval, limit the use of funds, the resource price increases and a series of fair and effective non punishment as a means of punishment, to ensure market binding.

Building compliance: Every year from 1st to 30th June, buildings have to be certified shall cancel at least the quota of carbon emission of previous years approved by TIFI by the account opened in the registration system, and the compliance obligation shall be fulfilled. The quota of the building is not enough to fulfill the compliance obligation, it can be purchased through transaction. If the quota has balance, it can be used in subsequent years or for transactions.

Every building can take positive measures to save energy and reduce carbon emissions. When the emission is less than the quota, the remaining quota will be sold to the market.

(4) Supervision and incentive mechanism

The fairness and effectiveness of the allocation of carbon rights will directly determine the operational efficiency of the carbon trading market. If the government cannot allocate quotas fairly for emission reduction units, It is easy to cause market distortions, resulting in emission reduction units of collective strike and even the formation of the black economy, so contrary to the original intention of the establishment of carbon trading, the formation of anti-effect. Therefore, as a major official agency for allocating quotas, the NDRC's Carbon Emissions Trading Commission needs to set up an effective quota allocation regulation system so as to ensure the fairness of distribution.

The building carbon trading mechanism also includes supervision mechanism, market supervision, pricing mechanism, price policy and other mechanisms. It mainly protects against the political risks, economic risks and project risks of carbon trading.

Supervision content: The following issues will be regulated by TIFI Companies and relevant departments: activities such as monitoring, reporting, trading and compliance of buildings have to be certified; verification activities of third party verification agencies; trading institutions conducting carbon emissions trading and information dissemination and other activities; other related business activities of market participants.

Funding and Project Support: The relevant departments of TIFI Company should support the prominent effect of energy conservation and emission reduction in the projects supported by building-related supporting policies and in-budget investments.

## 4.3 Greenhouse Gas Management Strategy of Yujiapu

In order to carry out GHG inventory in Yujiapu financial district smoothly and sustainably, and to provide basic carbon emission data for the construction of low-carbon model town in Yujiapu, the strategy for GHG management in Yujiapu is specially guidance on building carbon emissions internal verification two parts.

### 4.3.1 Comprehensive Control Procedure for GHG Inventory of Building in Yujiapu

This procedure is applicable to greenhouse gas inventory management within the boundaries of all construction organizations in Yujiapu Financial District and is implemented by the property units of each building.

First, set up the greenhouse gas inventory group. The group is responsible for dealing with greenhouse gas inventory and greenhouse gas verification and other related matters. The GHG group structure as shown below.

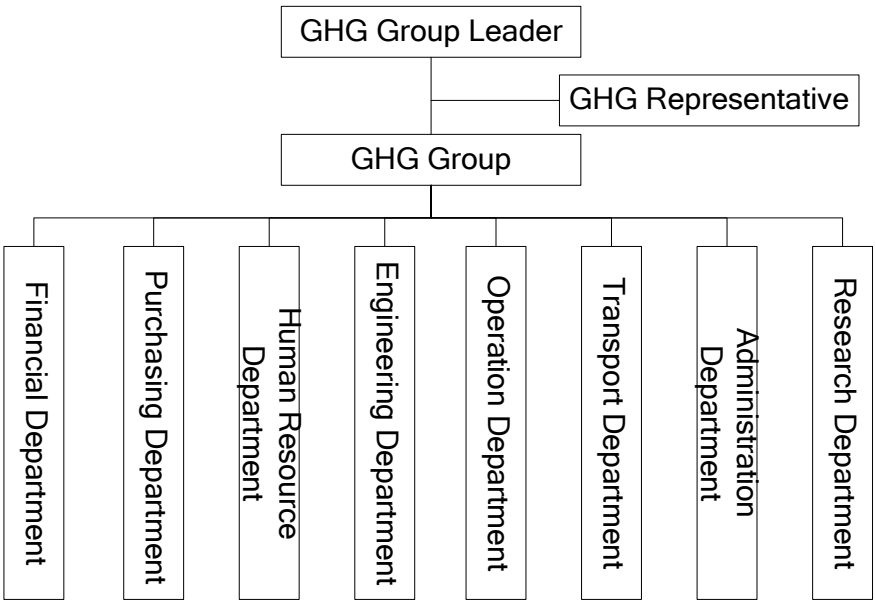


Figure 4.3.1 GHG Group Structure

Second, determine the internal space boundary and operational boundaries in Yujiapu area and the conditions for the abolition of greenhouse gas inventories. The space boundary is located in the periphery of the outer wall of the house, including the semi basement and the basement. According to the boundary of building operation direct GHG emissions and energy indirect GHG emissions and other indirect emissions of GHG division; for GHG emission or removal does not have a substantial impact, or technically difficult to quantify, or high cost has not obvious direct or indirect GHG sources and sinks of GHG shall be exempted from inventory.

Third, it is clear about the management of greenhouse gas information, documents and records in Yujiapu. The GHG group is responsible for establishing the inspection system for the accuracy of all data. In principle, a routine check is conducted every month, and a spot check is carried out every three months, and every year's spot checks cover all the data or credentials. The GHG team provides internal audit and technical review for the collection of greenhouse gas information every six months. The GHG team conducts a comprehensive review each year to seek improvements in greenhouse gas inventory and verification. The management of greenhouse gas files and records in the property unit is referred to the relevant quality management system documents and records control procedures, which is different from the quality management system documents and records management requirements. For the carbon dating base year, it is no longer changed until the base year is determined. The base year must be verified by the third party, and the data of the base year will use single year data.

### 4.3.2 Guidelines for the Internal Verification of Buildings' Carbon Emissions in Yujiapu

The procedure is suitable for the building's internal verification by Yujiapu property unit. The internal verification process is shown in the following figure. The main aspects are as follows: (1) The carbon inventory group submits the *Report on the Building Greenhouse Gas Emissions Quantification*; (2) the development and agreement of the verification plan; (3) the implementation of the internal verification plan; (4) The verification group prepares the verification report.

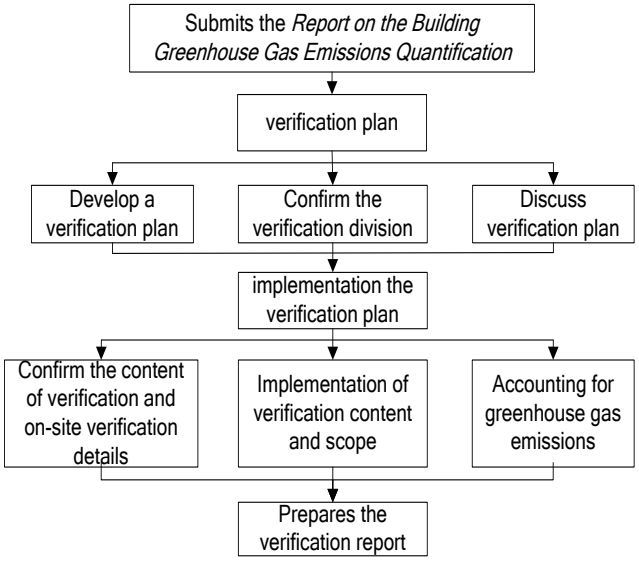


Figure 4.3.2 internal verification process for Building Greenhouse Gas Emissions

## 4.4 Green Ecological Urban Incentive Policy in Yujiapu

In order to promote the building of an energy-saving and emission-reducing comprehensive financial model city in Tianjin and improve the efficiency of the use of energy-saving and emission-reduction comprehensive demonstration city financial incentive funds, support the planning and construction of green eco-city areas and encourage districts to declare the reward funds. As the first Low Carbon Model Town in APEC, Yujiapu covers 100% of the green buildings in the starting area. In 2015, Yujiapu made a positive declaration in the financial district and made a successful application for 50 million reward funds by compiling the *Feasibility Study on Yujiapu Financial District Green Ecological City*. In order to guide the use of reward fund legal compliance, *Green Eco City Incentive Fund Management Approach in Yujiapu Financial District* and *Green Eco City Incentive Fund Use Plan in Yujiapu Financial District* are successively formulated.

(1) The basic principle

The allocation and use of incentive funds for comprehensive demonstration projects of energy conservation and emission reduction should follow the principle of overall planning, stressing key points, standardizing management, and being safe and effective, and should encourage demonstration projects of building energy conservation, increase the overall efficiency of building energy utilization and mobilize the enthusiasm of participants in building energy conservation effect.

(2) Basis and standard

- The total amount of green building project award is 90%, and the total amount of the capacity construction project award is 10%.
- Green building project: three-star Green Building reward 40 yuan / $m^2$, two star green building 20 yuan / $m^2$, one star green building 5 yuan / $m^2$.
- Capacity construction projects: 50% of the actual investment will be rewarded for the specific planning, index system and operation management involved in the capacity building.
- The contents of the compilation of the methods for the management of incentive funds and the review of the data and technology of the declaration projects are allocated according to the actual occurrence.
- The promotion of green ecological urban planning and the construction of regional

energy consumption monitoring system in the later period are allocated according to the proportion of the surplus amount of reward funds.

(3) Usage management

• The application for reward funds shall be submitted in principle by the construction unit or the owner unit of the project or may be entrusted by the construction unit or the owner unit to submit an application for authorization. The principle for applying for the incentive fund for capacity-building projects shall be submitted by the project undertaking unit or department.

• Green building project incentive funds are divided into two stages for disbursement. Green building obtained design logo, reward 40% of the total funds; Green building passed the completion acceptance, reward 60% of the total funds. If the project has passed the green completion acceptance, it can be allocated at once.

• For the special planning, index system, operation management and other capacity-building contents involved in capacity building, according to the actual completion of the project, reward funds shall be appropriated upon completion of the project.

(4) Declaration producer


(5) Performance management

• The application unit of the reward fund shall apply for the reward fund according to the actual conditions of the project. The unit of fund examination and approval shall be strictly scrutinized and the project that does not meet the requirements shall not be disbursed. If there is any provision of fake materials or fraudulent special funds, relevant units shall take appropriate measures to recover the disbursed Funds, and in accordance with the relevant laws and regulations be held accountable to the relevant units and personnel, credited to the corporate credit system violations.

• The units apply for green building should organize third parties to carry out the green completion acceptance work, it shall be supervised by the construction and transportation bureau of the central business district.

• Any unit shall not intercept or misappropriation the reward funds in any reason or in any form. If the relevant provisions are violated, they shall be disposed of in accordance with the relevant provisions.

# 5 Summary

As the First Low Carbon Model Town in APEC region named in 2010, Yujiapu sets targets on emission reduction clearly. During the development and construction, Yujiapu pays much attention to “5+1” elements, including low carbon energy usage, low carbon transportation, low carbon buildings, public service, low carbon system management and advanced facilities and equipment demonstration, and actively tries out first in low-carbon urban construction and low-carbon development. In the context of the global economic slowdown, after 5 years of comprehensive construction, the first phase of the starting area has been gradually completed and put into operation. Yujiapu has accumulated rich experience in urban planning soft power and construction hard power, and also encountered many challenges in urban planning and construction.

(1) The planning system of Yujiapu Financial District is perfect. On the basis of the traditional planning, the concept of low carbon innovation is integrated into the system. It is systematic, scientific and innovative. However, due to the differences between the special planning team and the professional orientations, the cohesion between the various specialties is not smooth enough and the consistency needs to be improved.

(2) At the beginning of planning, Yujiapu Financial District set up a platform company through government guidance to co-ordinate the overall planning, development and construction, investment attraction and operation and management of Yujiapu and set up coordination mechanisms of government, platform companies and developers to improve construction level and efficiency.

(3) Yujiapu Financial District is committed to build a large-scale high-star super high-rise green building in urban area. All the 15 buildings built in the starting area have been designed, constructed and evaluated in accordance with evaluation standards for green building design of China. The ration of green building in Yujiapu is 100%, and the ratio of high-star green building is more than 70%.

(4) 03-11 cooling center uses the automation and intelligent remote control system in the whole process, accurate positioning of pipelines and equipment maintenance information. The operation and management are fully automated and digital, to achieve intelligent operation and green management. But some buildings have not yet put into operation, the cooling demand is changing, so the cooling efficiency of the unit operation failed to achieve optimal.

(5) Yujiapu Financial District adheres to the concept of "Advocacy of Public Transport and Encouragement of Walking", develops in a transit-oriented development (TOD) mode, adopts a slow-traffic priority right to increase the travel rate of slow-traffic system and provide a low-carbon green traffic environment for the financial district.

(6) In the design and construction of Riverside Park and North Park, Yujiapu Financial District makes full use of low-carbon landscape strategies such as rainwater collection, local selection of carbon sequestration plants and ecological grass ditch to reduce the urban heat island effect; introduce a demonstration project of rooftop farmland to increase the three-dimensional green space and try to use urban vertical agriculture to further increase the urban carbon sink area and reduce the city's carbon level.

(7) During the planning and construction of underground space in the starting area, centralized planning is used to effectively utilize land resources, and at the same time, unified development mode is adopted to reduce development cost and avoid reconstruction after completion.

(8) Through the planning and construction of the underground common ditch, eliminate the street spider web to solve the "road zipper" problem of repeated excavation of the ground.

However, because of the more changes in the staging of underground space planning, there is also a problem of lack of continuity.

(9) In Yujiapu Financial District, we first try to take the initiative in the management area, take innovative strategy route, and put forward the greenhouse gas management strategy, the regional energy management system and low carbon action recommendations etc. to ensure the low carbon advancement and demonstration in Yujiapu.

(10) During the process of construction, we should carry out carbon verification research of the construction stage, establish a regional building carbon emissions trading mechanism, strengthen the control of carbon emission in green buildings' life cycle, and constantly improve the management measures or ways to reduce carbon emissions of green buildings.

# Part 2

# Yujiapu Experience Sharing Dissemination Roadmap

# Introduction

In 2014 APEC Economic Leaders' Declaration, the leaders of APEC economies stated “Recognizing the range of urbanization challenges and opportunities across APEC economies, we commit to collectively promote cooperation projects, and to further explore pathways to a new-type of urbanization and sustainable city development, featuring green, energy efficient, low-carbon and people-orientation.”

APEC Energy Working Group (EWG) has carried the Low Carbon Model Town (LCMT) Project since 2010. Currently, seven low carbon towns have been approved to explore low carbon pathway development among the APEC economies. Yujiapu Central Business District (CBD)/Financial District Development Project in Tianjin, China was selected as a case for the APEC LCMT Project Phase 1.

# 1 Background Information

## 1.1 Low Carbon Model Town (LCMT) Project

The APEC Low Carbon Model Towns (LCMT) project aims to combine energy-efficient buildings, transport and power systems to create communities that affordably reduce energy use and carbon emissions while creating pleasant living conditions. The LCMT project is a part of APEC's Energy Smart Communities Initiative (ESCI).

The LCMT project consists of three activities: a) Development and refinement of the "The Concept of Low-Carbon Town in the APEC Region" by the LCMT Study Group A; b) A policy review of low carbon development policy of each case town by LCMT Study Group B. c) A feasibility study of low carbon development for each case town by consultants hired by the APEC Secretariat.

To the date, there are seven towns involved in LCMT project as the case towns, they are Yujiapu CBD, Tianjin, China (Phase 1); Koh Samui, Thailand (Phase 2); Da Nang, Viet Nam (Phase 3); San Borja, Lima, Peru (Phase 4); Bitung, North Sulawesi, Indonesia (Phase 5); Mandaue, Cebu, The Philippines (Phase 6) and Krasnoyarsk, Russia (Phase 7).

## 1.2 Energy Smart Communities Initiative (ESCI)

The Energy Smart Communities Initiative (ESCI) was launched in November 2010 by the U.S. President Barack Obama and Japanese Prime Minister Naoto Kan within the APEC. ESCI has contributed greatly to the advancement of green growth, sustainable development, long-term job creation and APEC's goal of energy intensity reduction of at least 45% by 2035 with 2005 as the reference. It covers four main pillars—Smart Transport, Smart Buildings, Smart Grids, and Smart Jobs and Consumers—along with the cross-cutting examples of Low Carbon Model Towns.


（From：http://esci-ksp.org/）

One of the components of ESCI is the Knowledge Sharing Platform (KSP), a tool for collecting and sharing best practices for creating energy smart communities. The KSP, established at the EWG-41 meeting in Canada in May 2011, is designed to aid in cataloging and sharing information and best practices that are developed for ESCI's areas of focus. It presents an opportunity for researchers, scientists, academics and the general public to learn, engage and share the latest in sustainability and energy efficiency.

As a way to encourage best practices, facilitate knowledge-sharing and give public recognition to individual accomplishments in the energy smart related cases within the APEC region, ESCI-KSP hosts an "ESCI Best Practices Awards Program". The first awards occurred in 2013, the second awards in 2015 and the third awards in 2017.

ESCI Best Practices Awards（From：http://esci-ksp.org/）

## 1.3 APEC Cooperative Network of Sustainable Cities (CNSC)

APEC Cooperative Network of Sustainable Cities (CNSC) is part of “APEC Cooperative Initiative for Jointly Establishing an Asia-Pacific Urbanization Partnership” and had been approved in the Annual APEC Economic Leaders’ Meetings in 2014. During the following year, APEC Sustainable Energy Center (APSEC) had been identified as the official implementing organization for the leader's initiative by the APEC meeting documents.

Based on mechanism of APEC EWG, APSEC start to promote Energy Smart Community initiative (ESCI) and Low Carbon Model Town (LCMT) project and sets up CNSC as one of the pillar program. CNSC project will establish operation management mechanism, based on the theme of “City and Energy” to develop the research study about APEC urban sustainable development model, energy planning, energy technology, energy low-carbon transition, and organize technical training and expert workshops.

CNSC, currently includes one workshop, two networks, one training and one key publication.

- APEC Workshop on Sustainable Cities
- APEC Cooperative Network for Low-Carbon and Energy-Efficient Cities, APEC Sustainable City Service Network
- Trainings on APEC Sustainable Cities
- APEC Sustainable Cities Development Annual Report

CNSC
COOPERATIVE NETWORK OF SUSTAINABLE CITIES

（From：http://esci-ksp.org/）

# 2 Dissemination Roadmap

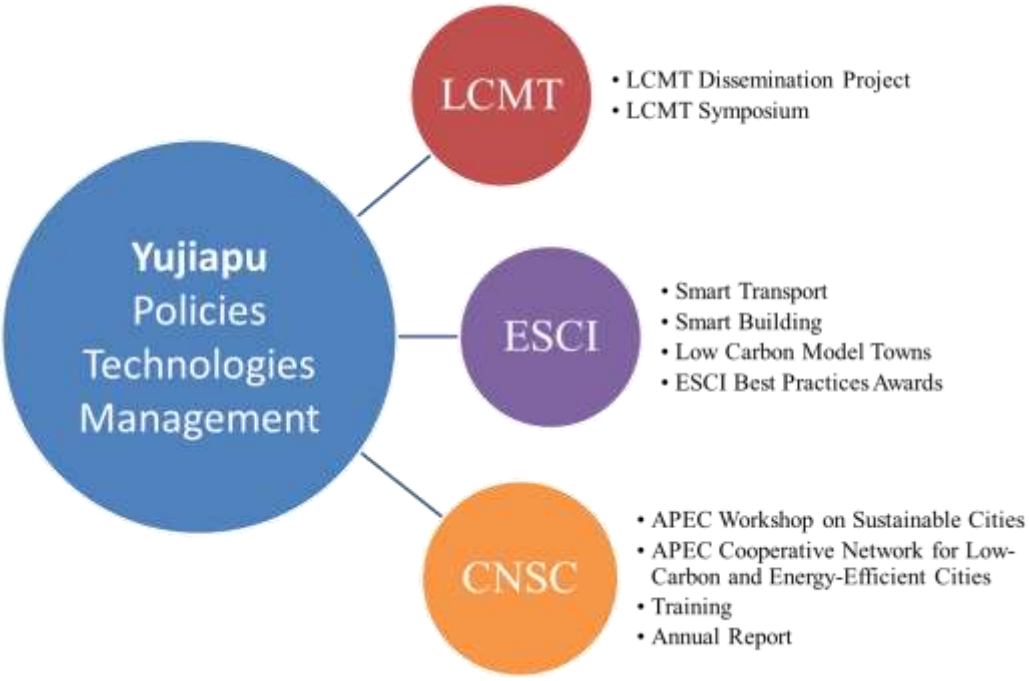


Figure2.1 Elements of Yujiapu Experience Sharing Dissemination Roadmap

Firstly, before the roadmap creation, there is a very important thing should be clear, what is the key experience of Yujiapu should be disseminated to APEC region. Since Yujiapu has been developed over five years, in this pried of time, it has lots of experiences in policies, technologies and management of low carbon model town construction and operation. Not only that, but Yujiapu has also produced its own low-carbon index system. The more details have been concluded in the following analysis of carbon reduction strategy and Low-carbon implementation path.

After that, the target should be set up as well, because Yujiapu financial district is the first LCMT as a case of CBD type of town, the target should be CBD type of the towns in APEC region. In the dissemination progress, Yujiapu experience can provide package of policy, technology and management to the nominated CBD town in APEC region.

According to the background information of LCMT, ESCI and CNSC under APEC EWG mechanism, the Yujiapu experience sharing dissemination can cooperate with LCMT, ESCI and CNSC to APEC region. Which it has been shown the elements of roadmap in Figure2.1.

## 2.1 Yujiapu Experience Sharing Dissemination in LCMT

Low Carbon Model Town Task Force (LCMT-TF) has transited the LCMT project to dissemination. According to the transition of LCMT Project and LCMT Dissemination Project, the basic ideas for Dissemination of LCMT are carrying out good practice of LCT-I on Volunteer Towns and using symposium for introduce knowledge of LCMT.

LCMT symposium is going to introduce knowledge of LCMT, including information sharing and concept introducing of advanced LCT projects in the world and previous LCMT case towns and LCT-I volunteer towns.

Figure 2.2 Aerial view of Yujiapu

Yujiapu experience sharing dissemination can cooperate with LCMT dissemination, it provides the package solution for the CBD type of volunteer towns. And then, Yujiapu experience will be disseminated through LCMT symposium.

Yujiapu can provide the low-carbon planning of CBD type city or town for dissemination.

- Low-carbon Building Planning
- Low-carbon Energy Planning
- Low-carbon Transportation Planning
- Low-carbon Space Layout Planning
- Low-carbon Landscape Planning


Figure2.3 Low-carbon special Planning of Yujiapu

Such planning package can be disseminated to the CBD type of volunteer towns. And also, Yujiapu Financial District Low-Carbon Town Index System is one of the most important input to LCMT dissemination and also a guide reference to the CBD type of volunteer towns.

## 2.2 Yujiapu Experience Sharing Dissemination in ESCI

ESCI-KSP is a tool for collecting and sharing best practices for creating energy smart communities, which contains the six catalogues including smart transport, smart buildings, smart grids, smart jobs, industry and Low Carbon Model Towns. Yujiapu is already in the catalogue of Low Carbon Model Towns, but the best practices of Yujiapu low carbon transport, low carbon buildings and low carbon system management have not been shared in the catalogue of smart transport, smart buildings.

According to the catalogues of Smart Transport in ESCI-KSP (Table 2.1) and Carbon Reduction Strategy of Yujiapu, Yujiapu experience on low-carbon Transport, such as TOD, BRT system, Rail transit, Slow-moving system of non-motorized vehicles & walking, Parking, Underground vehicular traffic & pedestrian system and Well-integrated public transportation system, contributes to energy efficient urban transport network in ESCI-KSP, with the best practices to Transit-Oriented Development, Bus Rapid Transit (BRT), Urban Rail Transit, Bikes and Walkways, Transportation Demand Management and Intelligent Transportation Systems (ITS).

Table2.1The catalogues of Smart Transport in ESCI-KSP

| | |
|---|---|
| Energy Efficient Urban Transport Network | •Energy-Efficient Vehicles<br>•Transit-Oriented Development<br>•Bus Rapid Transit (BRT)<br>•Urban Rail Transit<br>•Bikes and Walkways<br>•Renewable Energy in Transport Systems<br>•Transportation Demand Management<br>•Intelligent Transportation Systems (ITS)<br>•Other Transit Service Enhancements |
| Energy Efficient Freight Transport Network | •Energy Efficient Vehicles<br>•Corporate Initiatives<br>•Intermodal Freight Strategies<br>•Logistical Strategies |
| Electro mobility Survey and Roadmap | •Electromobility Organizations<br>•Electromobility Road Map |
| Electric Vehicle Demonstrations | •Electric Vehicle Infrastructure Demonstrations<br>•Electric Vehicle Charging Stations<br>•Electric and Hybrid-Electric Vehicles |

According to the catalogues of Smart Buildings in ESCI-KSP (Table2.2) and Carbon Reduction Strategy of Yujiapu, Yujiapu experience on low-carbon building, such as Green Buildings, Smart Building System and Energy management system, contributes to low energy buildings network in ESCI-KSP, which involves Building Performance Rating Systems, Low Energy Building Demonstration Projects and Low Energy Building Programs, Initiatives, and Partnerships.

Table 2.2 The catalogues of Smart Buildings in ESCI-KSP

| | |
|---|---|
| Low Energy Buildings Network | •Building Performance Rating Systems<br>•Low Energy Building Demonstration Projects<br>•Low Energy Building Programs, Initiatives, and Partnerships |
| Materials Testing and Rating Centers | •Testing Centers |
| Cool Roof Demonstrations | •Cool Roof Programs<br>•Cool Roof Analytic Tools<br>•Cool Roof Demonstration Projects |
| Low Energy Window Demonstrations | •Low Energy Window Organizations<br>•Low Energy Window Analytic Tools |

Yujiapu experience sharing dissemination should connect with ESCI-KSP to conclude the best practices in each catalogue of Smart Transport and Smart Buildings. Yujiapu experience and practices could be distribute to the relevant ESCI-KSP catalogues for increasing the dissemination impact.

ESCI-KSP hosts an “ESCI Best Practices Awards Program”. The first awards occurred in 2013, the second awards in 2015 and the third awards in 2017. It is the best way to disseminate Yujiapu experience in APEC region, if any practices can win the ESCI Best Practices Awards. After sharing the experience on ESCI-KSP, Yujiapu practices will apply the ESCI Best Practices Awards.

## 2.3 Yujiapu Experience Sharing Dissemination in CNSC

These Yujiapu experience will be issued in the APSEC network to disseminate by APEC Workshop on Sustainable Cities and trainings to continually enhance capacity building for whole APEC region.

APEC Workshop on Sustainable Cities is the platform to experience sharing, the 1$^{st}$ was held in Canberra, Australia, on 9th May, 2016, during APEC EWG51; the 2$^{nd}$ was held in Singapore, on 25th April, 2017, during APEC EWG53; and the 3$^{rd}$ will be held in Hong Kong, China, on 15th May, 2018, during APEC EWG55. Yujiapu experience has already been shared by the 1$^{st}$ APEC Workshop on Sustainable Cities, and the following Yujiapu experience will be disseminated through this flagship event to APEC region.

APEC Cooperative Network for Low-Carbon and Energy-Efficient Cities established since 2106, there were 7 cities in the 1st batch of APEC Cooperative Network for Low-Carbon and Energy-Efficient Cities, including Canberra (Australia), Adelaide (Australia), Bitung (Indonesia), Turpan (China), Kunming (China), Tianjin (China) and Zhenjiang (China). As the network grows, Yujiapu experience will be disseminated through this network to other cities as the key contribution of Tianjin.

Trainings on APEC Sustainable Cities contain Training, Technical Tour Study, Consultation and Project Promotion. Yujiapu experience will be disseminated through trainings, such as low-carbon planning (energy, transportation, space layout and landscape). Yujiapu can be chosen as the best example in the training process and also be chosen as the technical tour study base. Once Yujiapu win the ESCI Best Practices Awards, Yujiapu award experience sharing will be disseminated in APEC region.

Yujiapu experience on LCMT as one of the case study in the “APEC Sustainable Cities Development Annual Report 2017 - Mode and Concept” will be disseminated in APEC region.

# 3 Yujiapu Experience Sharing

Through analyzing the problems and challenges of Yujiapu and following the principles of operable and implementable, we study from the perspective of urban planning. According to the key indicators and links, the index decomposition path of planning strategies, from low-carbon urban space, low carbon Energy use, low-carbon travel, green building, low-carbon system management, low-carbon economy proposed carbon reduction strategy.

Yujiapu financial district low-carbon town index system (Figure3.1) starts from six aspects of low carbon environment protection, utilization of low carbon resources, low carbon space organization, low carbon traffic, low carbon economy development and low carbon city operation. To ensure the realization of various indicators in the low-carbon model town of Yujiapu financial district, these six aspects ensure the quantitative requirements of the indicators.

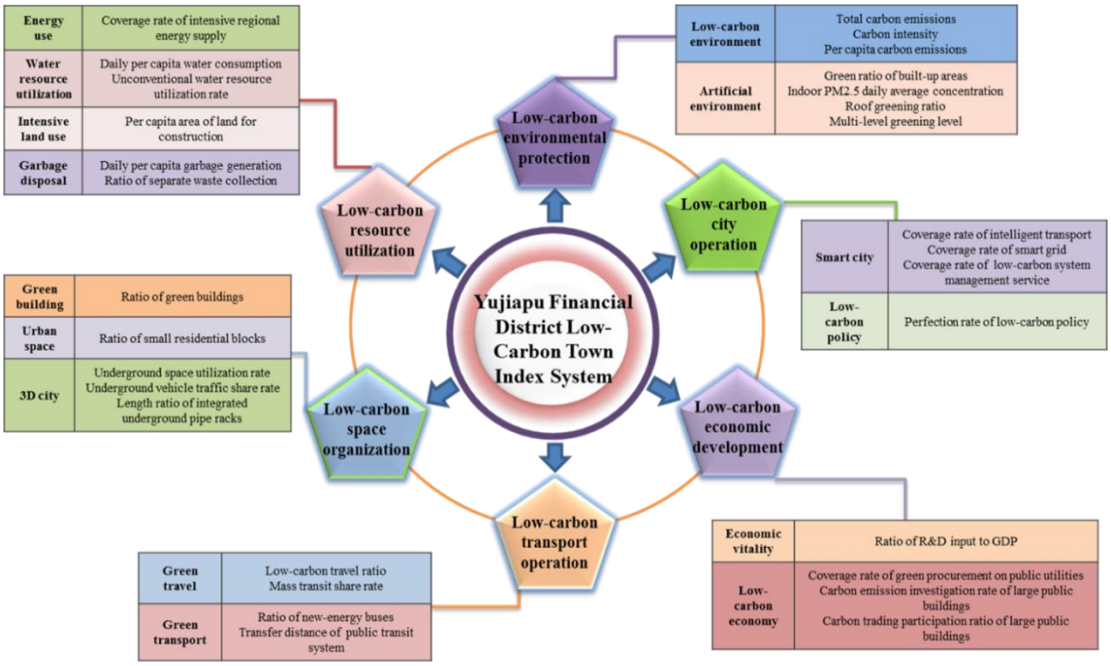


Figure 3.1 Yujiapu Financial District Low-Carbon Town Index System

However, in order to achieve a smooth implementation of the indicators, we have started six aspects of the implementation of specific targets from the low-carbon energy, low-carbon transportation, low-carbon construction, low-carbon system management, public service and low-carbon technologies displaying, which is "5 +1" low-carbon development model. The "5 + 1" low-carbon development model is the core and key to Yujiapu carbon reduction strategy and has established an important framework for the overall goal of low-carbon model town in Yujiapu financial district. (Figure 3.2)


Figure 3.2 Carbon Reduction Strategy of Yujiapu Financial District

Based on the Yujiapu index system, the low-carbon implementation path should be based on the indicators of low-carbon environment protection, utilization of low-carbon resources, low-carbon space organization, low carbon traffic, low carbon economy development and low carbon city operation, combined with the implementation experience of low-carbon cities at home and abroad, at the same time based on the characteristics of low-carbon, high-density and financial center in Yujiapu financial district, according to local conditions to choose low-carbon development path. Finally, the selection of the implementation path should also consider the possibility of "quantifying" the evaluation so as to evaluate the implementation of low-carbon model towns through the "Low Carbon Development Index of Yujiapu Financial District".

According to the selection principle of implementation path, the low-carbon implementation path of Yujiapu covers six aspects of low-carbon energy, low-carbon transportation, low-carbon construction, public service, low-carbon system management and low-carbon technology demonstration. (Figure 3.3)

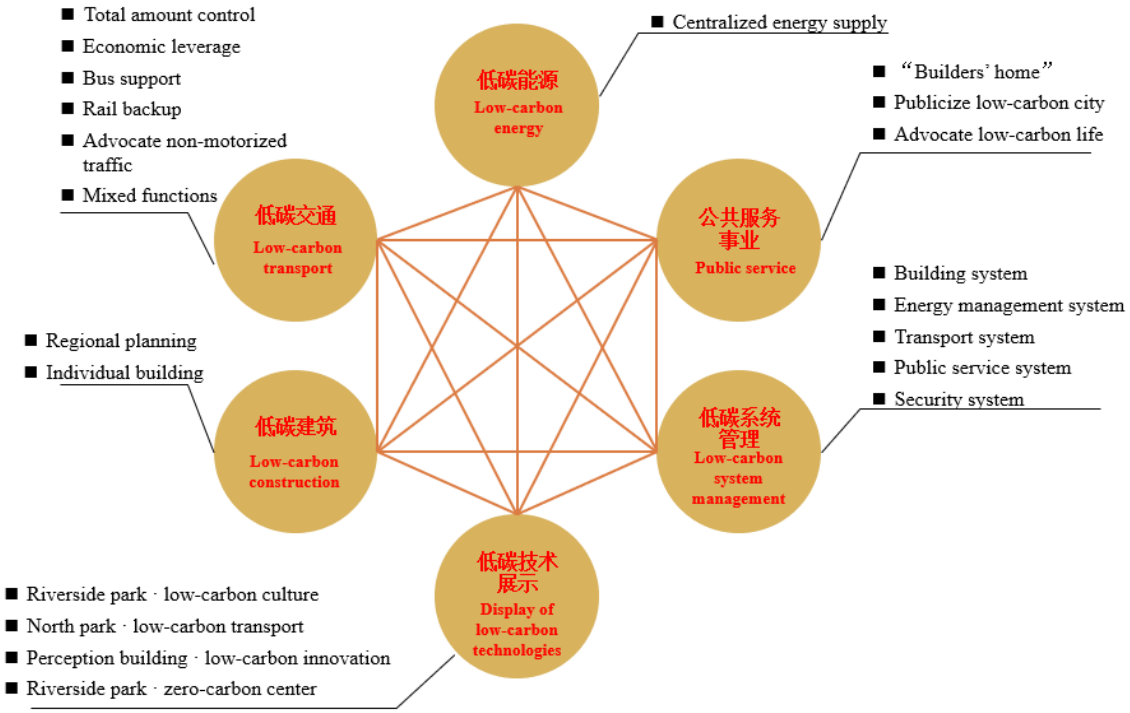


Figure 3.3Yujiapu Financial District Low-Carbon Implementation Path

## 3.1Low-carbon city space

- **Strategy**

In view of the disadvantages of high density, low-carbon urban space is realized through the adjustment and control of urban density, rational planning of space structure, saving land resources and reducing energy consumption. The per capita land for construction in China is more than 130 square meters, much higher than the 82.4 square meters per capita in developed countries and 88.3 square meters per capita in developing countries. Therefore, Yujiapu controls the per capita land area from the urban population density.

(1) The formulation of urban density should follow the urban population density and increase the population density within the allowable range of population capacity.

(2) Urban layout of microclimate. Yujiapu according to the characteristics of the regional climate, the use of computer simulation, optimization of architectural design orientation, adjust the neighborhood microclimate, is conducive to building energy efficiency and reduce carbon emissions.

(3) With the three-dimensional development of the CBD, Yujiapu vertically distributes all kinds of facilities scattered on the ground vertically in the three-dimensional spatial structure. The intensive design of the vertical space greatly reduces the need for scarce land resources.

(4) Urban spatial layout is compact, multi-center, cluster and network. Urban master plan is completed through urban climate design. All wastes are recycled. Intensive and multi-functional communities use advanced ICT technologies / Communication technology) to reduce traffic demand. It requires comfortable and seamless transfer of public transport systems, bicycle and pedestrian priority road networks. All buildings are built to green building standards with building energy efficiency levels above China standards. It should retain natural wetlands and green lands, and also develop urban agriculture for the formation of urban carbon sinks and carbon stocks.

## 3.2Low carbon energy

- **Strategy**

As for energy structure, due to the high density of cities, the energy demand for solar energy utilization is insignificant in comparison with the energy demand in the region, which is not realistic to implement. The regional energy model is more suitable for this high density, high volume rate of the city.

(1) Construction of regional energy station

1) With regional energy station as the mainstay, supplemented by self-built cooling and heating engine room, make full use of the complementary characteristics of air-conditioning load among single buildings, save the investment and cooling of cold and heat sources, and heat the floor area of the engine room;

2) According to the plot format and development timing, combined with public green space and underground space, planning and construction of eight centralized regional energy stations;

3) Adopting the forms of cold and heat source of mixed energy structure at the regional level and comprehensively utilizing the heat network, city gas, electricity and renewable energy in a targeted and comprehensive manner according to different formats and energy stations;

4) Buried pipe in the area, should be buried pipe ground source heat pump system;

5) Heating heat source should try to use the city heat network, daytime cooling load-based electric refrigeration, try to use ice storage system;

6) Gas must be used as input energy for heating, giving priority to the gas cold, heat, electricity triple supply;

7) The sale of residential buildings proposed the use of urban heating network heating, multi-unit or unit air-conditioning cooling, heating form.

(2) Establish a regional energy management system

1) Benefit from using energy-efficient technologies and equipment to achieve specialized contract management, improve energy efficiency, to save energy, reduce carbon emissions, reduce operating costs;

2) The comprehensive application and application of IOT technology to establish a comprehensive and easy-to-use smart energy management system with system early warning and expert advice functions for the carbon emissions trading platform to provide a data foundation and support to ensure the realization of energy-saving goals and sustainability.

3) The introduction of international energy management companies, the construction of unified management of energy stations in the region in order to achieve effective support for low-carbon operation.

- **Implementation**

As a CBD, Yujiapu is a densely populated area where large-scale and intensive development is carried out in high-density areas. Compared with energy supply of air-conditioners and hot water in all buildings separately, the energy center in the development area is used to concentrate the method of supply to each building can exert its scale and scale advantages and actively promote the process of low carbonization, which is the most effective measure for low carbonization of energy.

Through the research on the energy conditions, the cost of energy use right, the price of energy, the level of energy utilization and the dynamic load and the annual cooling and heat supply in Yujiapu area, based on the assessment of energy rationality, several regional energy

sources are planned and constructed Station, for the energy system must be independent of the construction industry, the use of self-built energy stations, and ultimately for the majority of Yujiapu area coverage. Construction of two large ice storage centers in the start-up area has started. The project, led by the SUEZ Energy Group, the world leader in energy conservation and environmental protection, is expected to be completed by June 2013 and will provide 2.28 million square meters of building services. In the long term, a total of 8 centralized regional energy stations will be built by 2020 with a service area of about 6.97 million m2, accounting for 72.9% of the planned construction area. In addition, in the area where buried pipes are used, the ground-source heat pump system should be adopted as much as possible to achieve the lowest carbon emission, heat island effect and water saving in the area of cooling and heating process. At present, it has been determined that the initial period construction will adopt waste heat from power plants and ice storage technology. In the latter part of the construction period, building materials and other clean energy and waste heat from power plants will be used separately and other renewable energies to provide low-carbon Cold and heat source.

In the mode of centralized energy supply in the region, taking into account the power supply conditions in Yujiapu and other factors, the use of cogeneration for district heating and cooling facilities planning. The use of ice storage technology, making ice at night and using ice for cooling during the day can both save costs and make full use of grid energy to achieve the purpose of energy saving and emission reduction.

Since Yujiapu is a high-density and intensive area, the utilization of renewable energy is not very effective in reducing overall CO2 emissions. However, it can be used as a demonstration project for low-carbon technology exhibitions. Therefore, in the process of construction, we can try to dispose solar photovoltaic power in phases or develop and utilize solar energy by integration of photovoltaic buildings. With the goal of low-carbon demonstration of renewable energy as the goal, while using renewable energy, we should enhance environmental publicity.

## 3.3Low carbon traffic

- **Strategy**

High density and high volume inevitably attract a large number of people into the Yujiapu area. Low-carbon traffic needs to solve the congestion problem brought by a large number of people and to reduce the carbon emission of automobile exhaust in this area. In order to enable low-carbon cities to achieve their strategic objectives, the following points are focused on:

(1) The land layout is used transit-oriented development (TOD). It is adopted to emphasize the mixed development model of associated maps within 300 meters of the rail transit station, including at least the areas for public management and public service facilities (type A), commercial service land (Category B) and residential land (category R2), thereby reducing commuter flow in the area.

(2) Set the underground vehicular traffic and pedestrian system with the vertical three-dimensional traffic mode. Research shows that if the average speed is reduced from 50km / h to 30km / h, the carbon emission will increase by 10% accordingly. Increasing the speed of the vehicle will help to reduce carbon emissions.

(3) Urban density is sufficient to motivate non-motor vehicles and public transport trips.

(4) The urban morphology adopts the micro-design to encourage people to walk and ride in the financial district.

(5) The social service network in the financial district is formed by a well-integrated public

transportation system.

(6) Planning the BRT system: BRT leased line to improve accessibility and accessibility of public transport, ensuring rapid connectivity of the transportation infrastructure with the central urban area and weakening the inter-city distance.

(7) Develop rail transit and adjust land use along the track to enhance its strength.

(8) Plan the slow-moving system of non-motorized vehicles and walking in the whole region and improve the convenience of slow-moving system and public transportation.

(9) The parking implements area billing and limits the private vehicle using.

- **Implementation**

According to the research data, urban traffic plays a major role in the increase of urban greenhouse gas emissions, with carbon emissions from transport accounting for an average of 33% of total urban emissions. At the same time, Yujiapu Financial District, as the world's largest financial and business district, plans to have a daily working population of about 300,000 and a night-time resident population of 70,000. Both urban and population density are very high. The phenomenon of tidal traffic is obvious and faces huge traffic pressure. Therefore, the low carbon traffic is an important way to achieve low-carbon city.

To achieve low carbon traffic through the following specific measures:

(1) Total amount control

Control the total amount of traffic trips and reduce the number of motor vehicles entering Yujiapu financial district, especially home-use private cars. And formulate relevant policies and measures such as controlling the number of car parking spaces and other effective means of private car. The total control can ease traffic congestion, reduce the overall level of carbon emissions.

(2) Economic leverage

Try to raise parking fees and differentiated parking charges. It is focused on regional traffic congestion charging system (such as Singapore, London, Stockholm, etc.), subsidies for urban public transport operating costs.

(3) Public transport

Strengthen the planning of public transport routes to deepen and enhance combined with the actual construction, the status and the planning adjustments and other reasons. Strengthen public transport hub and station construction to ensure that the distance between public transport system stations is less than or equal to 400m, provide a more convenient public transport environment for crowd travel, and promote the development of low-carbon transport. Public transport priority will be given to the construction of public transport facilities, public transport funds, focusing on rail transport, conventional bus systems and integrated transport hubs. Strengthen the management of vehicle energy efficiency standards to ensure that the vehicle emissions in the region to achieve the China energy efficiency standards. Regional public transport vehicles should be preferred energy-saving vehicles or new energy vehicles. It focuses on the development of rail transit as the mainstay of the public transport system. By 2015, public transport will become the major mode of transport in the region and the vast majority of public transport vehicles will be powered by new energy sources.

(4) Slow-moving system

Build underground public pedestrian system network and a certain number of bicycle storage facilities and also provide all-weather walking facilities. It is very important to encourage the use of slow traffic travel. By 2015, it achieved a steady increase in the proportion of walking and bicycle travel.

(5) Mixing function

Cooperate with the surrounding areas, strengthen the multi-functional mixed use of regional land, and improve the mix of residential, employment, education, medical and commercial functions to ensure the functional integrity of the city and improve the balance between job and housing, and help to reduce unnecessary traffic travel and reduce work and life travel time.

## 3.4Low carbon building

- **Strategy**

Yujiapu requires that all buildings under construction in the district be green-labeled buildings, and plans to build vertical agriculture and low-carbon landscapes, and enhances urban greening areas vertically and horizontally to increase carbon sequestration.

(1) Green buildings have strict rules on energy saving, water saving and garbage disposal, which will help energy saving and reducing of carbon emissions in Jiabao area.

(2) Considering the energy consumption characteristics of high-rise buildings, the Green Building focus on the improvement of building energy efficiency.

(3) Increase the percentage of high-grade green buildings and increase the energy-saving ratio.

(4) Construction of green building in Yujiapu follows the Green Construction Guidelines to ensure the construction quality and the energy-saving effect of the green facilities in the later period.

(5) The integration of building decoration reduces the emergence of construction waste, as well as traffic and transportation.

- **Implementation**

Low-carbon building refers to try to improve energy efficiency, reduce energy consumption and reduce carbon dioxide emissions when the building materials manufacturers in the production of building materials, equipment, the owners using the building, ang the construction unit in the construction, demolition of buildings, Thus, low-carbon buildings emphasize the energy consumption and carbon dioxide emissions of the various elements of the building. Only by calculating and analyzing the energy consumption and carbon dioxide emissions of each component of a building can we judge whether it is a low-carbon building.

The concept of low-carbon buildings and green buildings are basically the same, but green buildings emphasize the "saving" of buildings from the point of view of energy consumption. In addition to the "saving" of buildings, low-carbon buildings emphasize "emission reduction" and "low emission". Low-carbon buildings, not only consider the city's buildings, but also take into account the building's energy consumption issues. In simple terms, the building should be low-carbon in a complete life cycle of design, construction, use and disposal.

In view of the high-intensity and high-strength development mode of Yujiapu financial district, the implementation of low-carbon buildings should be considered from two aspects: regional planning and single-entity construction.

(1) Regional planning level

In the development and construction of Yujiapu Financial District, we insisted on the principle of planning first, vigorously promoted green and energy-efficient buildings, strictly enforced mandatory standards for energy-saving of new buildings and a system for assessing the rational use of energy, applied green energy-saving design methods and construction technologies to promote new construction Green building energy-saving construction, to achieve the proportion of green buildings reached 100%, and more than two stars reached the

goal of 70%.

Based on China's green building standards, we conducted a special study on green building in the region, determined green building planning standards, formulated low-carbon transportation planning, regional energy station planning, green building planning, underground space and slow-moving system planning, landscape planning and management Network and common ditch planning, to build a low-carbon building a high starting point for the implementation of the platform.

(2) Single building level

Introduce low-carbon concept in architectural design, by the widespread using of low-carbon building technology, such as making full use of solar energy, the selection of building materials insulation, rational design of ventilation and lighting systems. In operation, promote low-carbon decoration, promote the use of energy-saving lamps and energy-saving appliances to encourage the use of energy-efficient air-conditioning systems to "save energy and reduce emissions" from all aspects and effectively reduce the carbon emissions of each building.

A large number of super high-rise buildings have been planned and constructed in Yujiapu financial district. High-rise buildings come with intensive, vertical development, image prominent, can be used as landmarks and other advantages, but also bring high energy consumption, poor indoor environmental quality, impact on the urban environment, and higher cost of construction and maintenance. Therefore, super high-rise buildings should focus on optimizing the design and control of the whole process of energy, water resources, selection, use, maintenance and emission of building materials through the implementation of environmental factors such as control and regulation of indoor air quality, thermal comfort, lighting and ventilation. And through the establishment of convenient functional system, the implementation of intelligent control, to ensure operational safety. In addition, the Yujiapu high-rise building mainly adopts the framework of the core tube structure system, the main structural materials used in the construction of high-strength steel, for greatly reducing the amount of materials, increasing the use of building area, effectively reducing carbon emissions. At the same time, super high-rise buildings generally have the characteristics of large building area and complicated functions. They have abundant waste water resources themselves and can be effectively reduced to the purpose of saving water by using the reclaimed water technology.

At the same time, the total increment cost of green building is controlled within 300 ~ 500 yuan per square meter of building area. The total energy consumption of building design is lower than 80% -70% of the stipulated value of energy-saving standard approved or filed by the state.

## 3.5Low carbon system management

- **Strategy**

Yujiapu aims to achieve low-carbon smart city, through wireless internet, internet of things, intelligent transportation, intelligent building, intelligent safety monitoring.

Intelligent transportation is to make full use of the theories of computer technology, communication technology, system engineering and other disciplines in traffic management and service, to effectively alleviate traffic congestion and improve the traffic capacity of the road network so as to achieve the goal of overall emission reduction.

The city energy management platform provides remote monitoring, auditing, control, management and other services to monitor and manage the 24-hour online application of computers and realize energy use. Measurable, verifiable and sustainable energy

management system can effectively save energy use and reduce carbon emissions.

Intelligent building is an effectively managed and operated environment with all aspects of related systems. It is compatible with all its internal systems (such as building automation systems) and organically form part of a smart city that sends key event information to the city command center and accepts instructions from the city command center. Intelligent building management provides integrated solutions that include energy management, facility management, space management, operations services, energy efficiency and carbon reduction.

- **Implementation**

It provides low-carbon management system, and thus constitute economic and social development platform for building a smart low-carbon community to Yujiapu financial district, from the building, transportation, energy, public services, security and other aspects.

(1) Building System

Building system includes equipment physical condition monitoring system, personnel perception service system and article electronic label monitoring system. According to the needs of terminal clients, property management needs and social management needs and other practical conditions, it choses configuration-related subsystems and establishes service subsystems or inter-related with other systems. The association between service subsystems provides different perceptual services to terminal clients.

Building system based on GIS and 3D technology, all equipment physical status, personnel status, item information, alarm information should be intuitive and dynamic display on the map. Cooperate with the smart of low-carbon energy management system to effectively supervise and alarm the use and storage of important equipment, valuable financial assets and instruments.

(2) Energy management system

Comprehensive application of energy management in the Internet of Things technology to provide a comprehensive and easy-to-use smart system, with system early warning and expert advice function for the carbon emissions trading platform to provide a data foundation and support to ensure the realization of energy-saving goals and sustainability.

(3) Transportation system

Establish a road traffic information collection system in the area and connect it with the municipal traffic information platform to improve road traffic information service and traffic monitoring system in the area. Establish a parking management and guidance system in the area and use IoT technology to detect the real-time status of the underground parking spaces. Develop the intelligent bus system, technically ensure the normal and rapid operation. Use the multimedia terminals for the public to provide public transport information services, road traffic conditions and traffic information. Provide a reference for the traveler to choose a reasonable route; and the bus stop should reduce the wait time for the traveler by providing information such as the waiting time for the passenger to release the transfer vehicle or the current location of the vehicle for transfer.

(4) Public service system

The public service system includes the system that can be used in the public area of financial district, public infrastructure and service public users, including substation intelligent assistant system, intelligent monitoring management system of distribution network, drainage network monitoring system, public utility service monitoring and metering system and public lighting management system.

(5) Security system

Yujiapu financial district security system for the protection of objects within the building and public areas, it focuses on building interior security system and public area security system, which parts are weak areas for safety precautions. Security system provides a standard and open integrated interface to provide security data for the future city comprehensive management and control platform in Yujiapu financial district.

## 3.6Public services

- **Implementation**

It should construct reasonably the layout of supporting public service facilities such as schools, hospitals, shops, residential and other facilities. Supporting public projects and the scale must be consistent with the size of the population.

Organize low-carbon city propaganda and planning to enhance urban influence, such as low-carbon city image film, low-carbon planning propaganda film and promotion film. Encourage society to organize various low-carbon propaganda activities, such as low-carbon economy exhibition and low-carbon propaganda education base. Make full use of the functional characteristics of smart cities to further strengthen the promotion of low-carbon culture, through the network, e-commerce and other.

Establish a multi cooperation mechanism to promote the participation and cooperation of the government, enterprises, trade associations, consulting companies, investment companies, research institutes and the media. At same time, organize the planning of carbon footprints salon and establish a low carbon association to advocate and practice low-carbon lifestyle.

## 3.7Low carbon technologies demonstration

- **Implementation**

It is good way to promote low-carbon concept, popularize low-carbon knowledge, demonstrate low-carbon technology and display low-carbon achievements by displaying facilities and equipment. Through the demonstration of high and new science and technology, the "zero-carbon emission" demonstration should be strengthen in the region.

The low-carbon concept and the applied low-carbon technology and equipment introduced in the construction of Yujiapu will be fully displayed to the public by the design of the visit route. And set different tour routes according to the different objects of visit. According to the characteristics of different sites, different visiting topics are set respectively. The main exhibition projects are Riverside Park, North Park, Perception Building, Urban Agriculture, Zero Carbon Center and others.