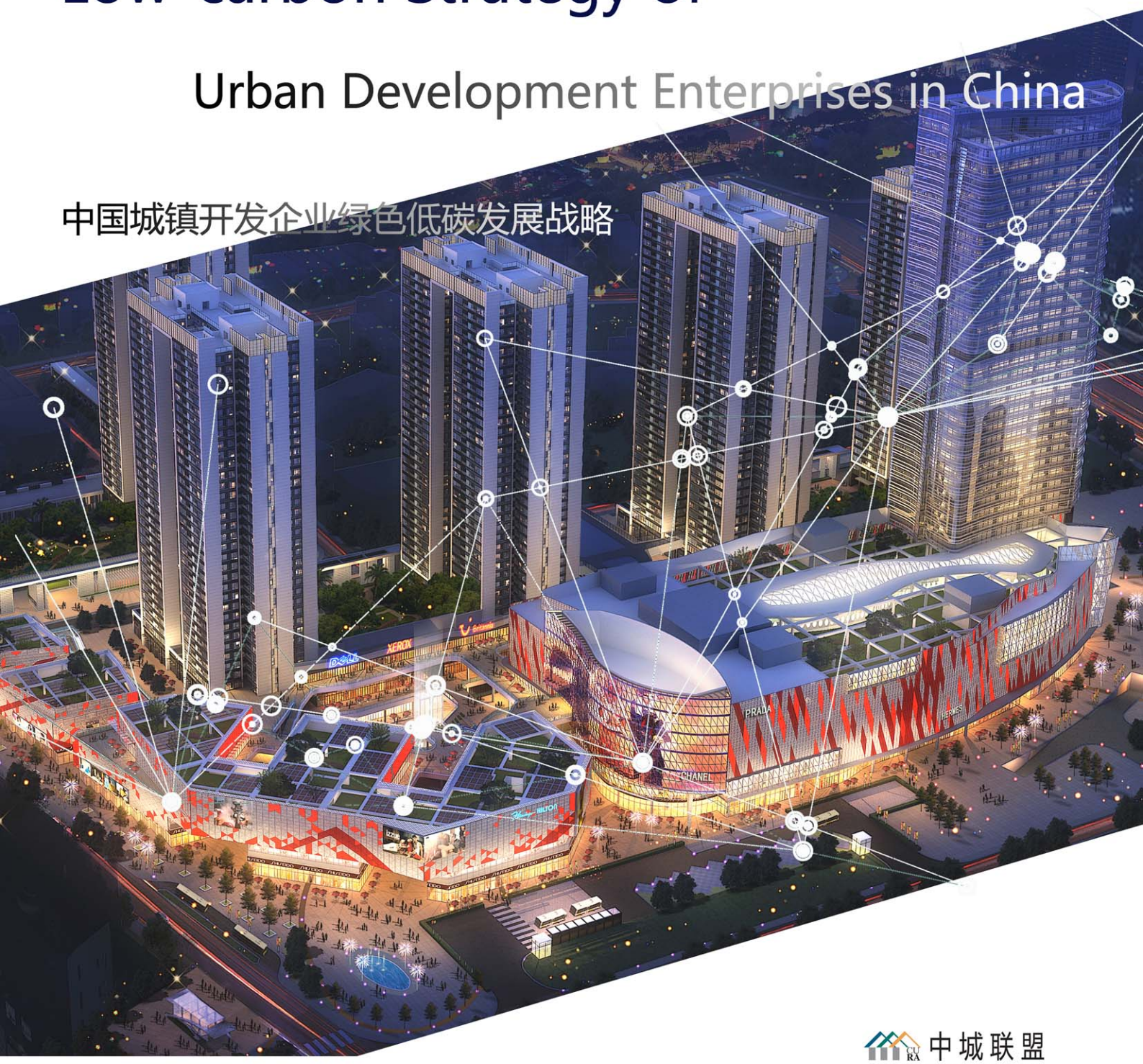
Low-carbon Strategy of

Urban Development Enterprises in China

中国城镇开发企业绿色低碳发展战略



中城联盟
中国城市房地产开发商策略联盟
CHINA URBAN REALTY ASSOCIATION

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Preface

China has been faced with severe resource and environmental pressure and carbon emission reduction pressure over the years as China's urbanization process speeds up and economic level improves. The Chinese government has rolled out the strategy for new-type urbanization development, placed "ecological civilization" to a point that is identical with socio-economic development, and successively promulgated various plans and policies that support and encourage cities to embark on sustainable construction and development, thus ushering in a nationwide green construction boom.

As the most influential urban development enterprises in the industry, the China Urban Realty Association has made massive beneficial attempts and explorations based on the core value and concept of green development, as a way to actively respond to the national call. More than 90% of the development enterprises of the Association are exploring into green buildings, with a view to make more contributions to building beautiful dwelling spaces and fulfilling the green dream. In order to facilitate innovation in green technologies for urban development, the Association has set up the Green Committee under the theme of "Imagining the Green Future", which exclusively studies on the development of green buildings, and maintains sound communications with the China Green Building Council, the US Green Building Council and other institutions.

As part of the efforts to follow up international actions to combat climate change, Chinese green development enterprises have actively explored into the strategy for urban green and low-carbon development, and taken popularizing green buildings, building green communities, guiding green development throughout the industry chain, and smart communities as the major development directions down the road. It's hoped that with the concerted efforts of businesses, governments and the general public, they could enhance communications and cooperation with the international community, facilitate the large-scale development and industrialization process of green development in China, and boost China's sustainable development, thereby contributing to the global fight against climate change.

Part 1 Status Quo and Challenges of Urbanization Development

Development History of Urbanization in China

China is currently experiencing an unprecedented large-scale and rapid urbanization process which is synchronous with mechanization, industrialization and intelligentization .

Statistics from the National Bureau of Statistics (NBS) shows that China's urbanization ratio maintained an average annual growth rate of 1.02% from 1978 to 2013. During this period, permanent population in urban areas rose from 170 million to 730 million (Figure 1-1), with the number of cities increasing from 193 to 658, and the number of organic towns from 2,173 to 20,113. By the end of 2013, China's urbanization rate reached 53.7% (Figure 1-2). It's predicted that China's urbanization rate would amount to about 70% by 2030. Rapid urbanization has become an important symbol of China's development.

Over the past three decades, China has made great strides in urbanization. Urban development has become the pillar of the national economy, and China has witnessed great improvements in urban landscape, the well-being of urban and rural residents, construction of housing, transportation and various facilities, social welfare and its residents' rights and interests. Since the reform and opening-up policy was implemented in 1978, China's construction industry has embarked on a road featured by dramatic development, and the annual area of structure commenced has been maintained at 2 billion m^2, accounting for roughly 45% of new buildings across the globe. In 2012, the per capita floor space of residential buildings of urban residents grew from 6.7 m^2 in 1978 to 32.9 m^2. For now, the area of existing buildings in China has surpassed 50 billion m^2, and the annual completed area of structure has exceeded 3.5 billion m^2. (NBS, 2013)

Over the past three decades, China has made great strides in urbanization. Urban development has become the pillar of the national economy, and China has witnessed great improvements in urban landscape, the well-being of urban and rural residents, construction of housing, transportation and various facilities, social welfare and its residents' rights and interests.

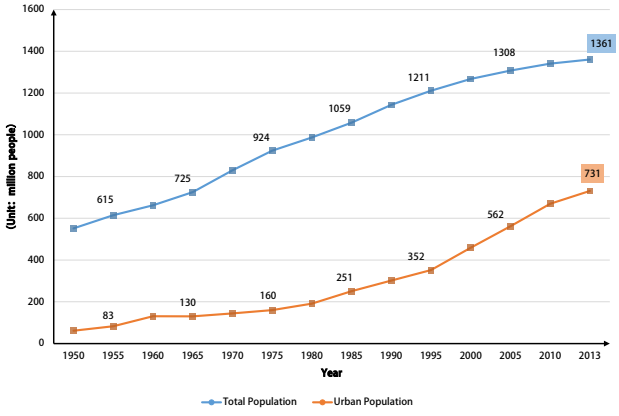


Figure 1-1 China's Total Population Changes (1950-2013)
(Source: China Statistical Yearbook 2014)

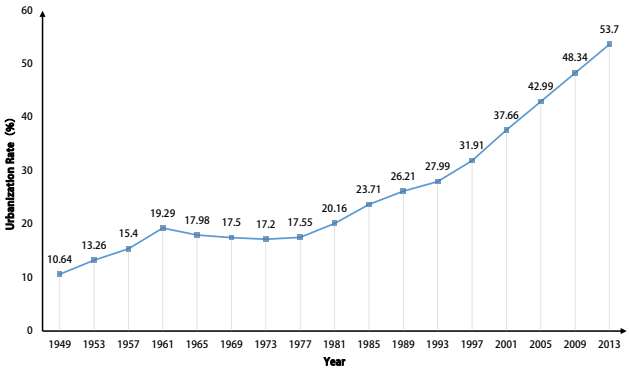


Figure 1-2 Rising Trend of Urbanization Rate
(Source: China Statistical Yearbook 2014)

China's New-type Urbanization Strategy

New-type urbanization means remaining people-centered and advancing urbanization which puts people first.

-- Xi Jinping

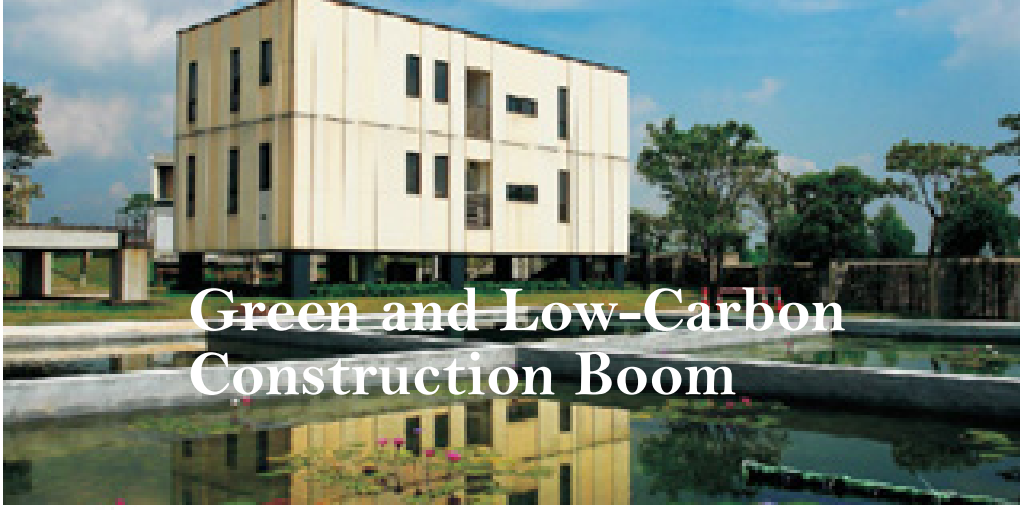
The ultimate goal of urbanization is to promote economic transition and upgrading, social harmony and advancement, and realize human welfare and happiness.

China has highly valued new-type urbanization, vigorously advanced ecological civilization and new-type urbanization in a synchronous and coordinated manner, and emphasized to embark on a new-type urbanization road featuring intensive, smart, green and low-carbon development. In March 2014, the Communist Party of China (CPC) Central Committee and the State Council released the National New-type Urbanization Plan (2014-2020), requiring to:

- Promote people-centered urbanization and comprehensively improve the quality of urbanization;
- Promote the coordinated development of large, medium and small-sized cities and small towns, with city agglomerations as the major form;
- Make urban development more sustainable, with the comprehensive carrying capacity as the support;
- Embark on a new-type urbanization road with Chinese features that puts people first, advances with informatization, industrialization and agricultural modernization synchronously, optimizes layouts, and attaches importance to ecological civilization and cultural inheritance;
- Push for green development, cyclic development and low-carbon development, save and intensively use land, water, energy and other resources, enhance environmental protection and ecological restoration, reduce interference with and damage to the nature, and phase in the green and low-carbon production method and lifestyle, and modes of urban construction and operation.

China's rapid urbanization has brought about opportunities, as well as challenges, such as tightening resource constraints and severe environmental pollution. As China's national economic power enhances and urbanization develops in an in-depth way, more and more people have paid attention to and thought of the ways of better safeguarding and meeting the rights, interests and benefits of each and every individual, and realizing a harmonious co-existence between the nature and cities. Hence, people are urgently calling for building high-quality and livable cities that are defined by healthy environment, pleasant spaces, coordinated functions and sustainable resources. As time goes by, decision-makers, developers and users have gained latest understanding about the low-carbon and people-first development quality. The market trend has also pointed to the public's preference for high-quality development after the national housing policies are adjusted.

In the meantime, urban industries are undergoing a transition to become more innovation-driven. The requirements for the integrated development of cities and industries, rapid development of e-commerce, and changes in residents structure have put forward still more diversified demands for land development. For instance, the demands of youth smart innovation industry for communications and mixed development, and the senior citizens' demands for convenience, post-retirement life and convenient mobility are questions that deserve meticulous considerations and studies. In this connection, to achieve development, it is the only road for China to realize urbanization transformation and development, make urbanized population the real masters of cities, and embark on a low-carbon and eco-friendly road.



Green and Low-Carbon Construction Boom

Guided by the strategy for ecological civilization and new-type urbanization, more and more Chinese cities have selected the path of low-carbon, green and intensive development. According to the data in the Report on the Urban Planning and Development in China (2012-2013), most of the Chinese cities have made clear their urban development goals based on the “eco-city” or “low-carbon city” and other eco-friendly development models. At this point, more than 100 cities in China are actively engaging in the construction of low-carbon eco-cities, and entered into broad international cooperation on the construction of eco-cities. A batch of pilot eco-cities, represented by Sino-Singapore Tianjin Eco-city, and Guangming District, Shenzhen, have gained sound demonstrative effects in the transition and development of Chinese cities. China becomes a well-deserved vanguard country in realizing the sustainable development of cities.

Over the years, various ministries and commissions of the Central Government have successively rolled out a host of supporting policies, encouraging provinces and municipalities to explore into various modes of construction of eco-cities. Among others, the National Development and Reform Commission (NDRC), the Ministry of Environmental Protection (MEP), and the Ministry of Housing and Urban-rural Development (MOHURD) are pushing forward eco-friendly, green and low-carbon cities and smart cities. Since 2012, the Ministry of Finance (MOF) and the MOHURD have successively approved 26 “state-level model green and eco-cities”, requiring all new buildings within these model cities to meet national one-star and above standards for green buildings. Among them, each of the 8 pilot cities of the first batch has received about RMB50 million in subsidy from the central budget; the MOHURD has successively announced 290 national pilot smart cities. The concept and measures of green development have been integrated into the planning of a large number of new cities in varying degrees.

Thanks to the guidance of national strategies and the practices and efforts made by development enterprises, China’s green buildings have achieved a rapid development and scored remarkable results. Since the Green Building Label project was initiated in 2008, China has seen the rapid growth in the area of structure of labelled projects (Figure 1-3).

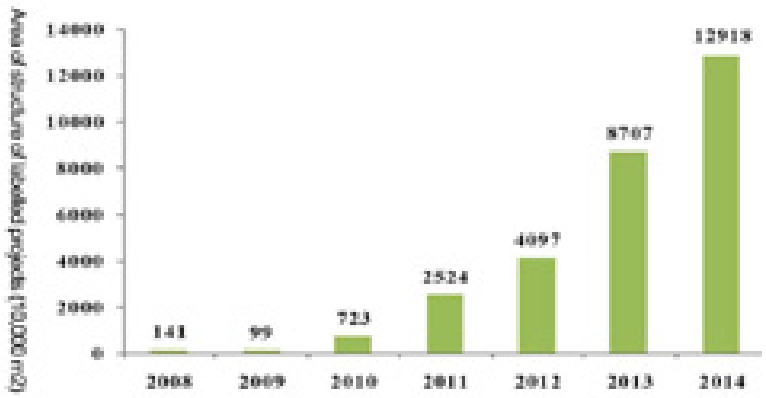


Figure 1-3 Growth in the Area of Projects with Green Building Label in China

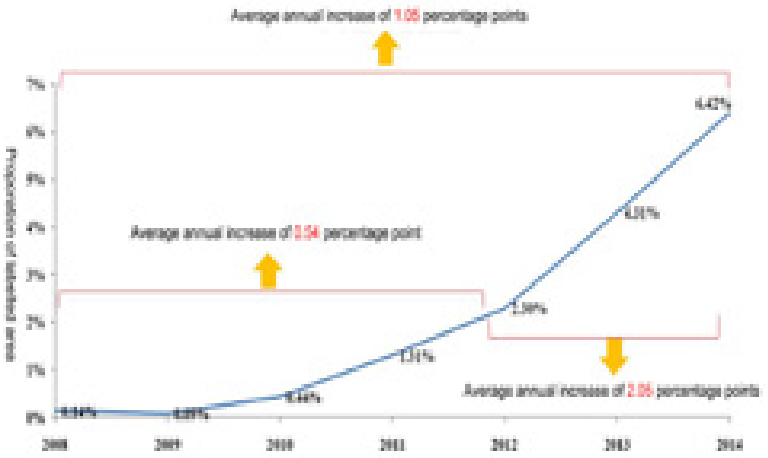


Figure 1-4 Growth in the Proportion of the Area of Projects with Green Building Label in China (2008-2014)

As the MOF and the MOHURD promulgated the incentive policies on advancing the development of green buildings in 2012, the proportion of the area of labelled projects grew at an evidently increasing rates between 2012 and 2014, with the average annual growth rate reaching 2.05 percentage points (Figure 1-4). The increase is not only reflected in the number of projects with green building label in China, but also reflected in the larger size of individual architectural project than overseas green buildings, with the average area of structure standing at about 100,000 m^2. By the end of 2014, the total area of structure with green building label in China reached 290 million m2, making China a global leader in this respect. China has ushered in a green and low-carbon construction boom, and established a vigorous market development atmosphere.

Part 2 : Low-Carbon Practice of Urban Development Enterprises and Best Practical Cases

Real estate enterprises are the main bodies that develop green buildings, and the progress of green buildings would be impossible without the promotion by enterprises.

Practices of Development Enterprises

In 1998, China formed her true real estate market after abolishing the welfare housing system. From the perspective of housing generation method, real estate development became a vital conduit for residential housing supply, whose percentage in the urban housing construction investment surged from 48.3% in 1998 to 83.9% in 2009(the percentage had generally been stabilized at over 83% since 2005). Real estate enterprises are the main players to develop green buildings, whose promulgation can not be achieved without promotions by enterprises.

Based on the rank list of green real estate developers in the 2013 Annual Report on China Green Real Estate Development by China Real Estate Business newspaper, the top-ranking real estate enterprises such as Vanke, Landsea, CMPD, Greenland, Wanda and Franshion Properties unanimously consider developing green buildings an inevitable trend for their products' transitions and updates as well as a necessary choice to occupy the market. Thus they all devised development strategies for green buildings at a relatively early stage, constantly improving their products' greenization levels and qualities. By making enterprise standards to guide subsidiaries of all levels to develop green products, they have gradually integrated green requirements into the products' management procedures, embedded green ideas in the nature of these products and highlighted differentiated technical features, in order to forge green building brands that demonstrate their respective uniqueness.

For example, Vanke emphasizes "building industrialization" and established its building research center back in 1999 to widely study technical issues in buildings. It adopts precast concrete structures and prominently features greenization during the construction process. Landsea highlights "Stable temperature, stable humidity, stable oxygen supply". It enjoys lucrative profits through improving comfort levels of their products, underlining higher product qualities in use. Wanda stresses "smart business management". It develops the Huiyun System that places its emphasis on green operations during the using process. Modern Green Development Co.Ltd. highlights "design and operational energy-saving" that optimizes energy supply solutions. It provides comfortable living space to customers at lowered energy consumption, thus achieves a relatively high percentage of green building operation label-covered area.

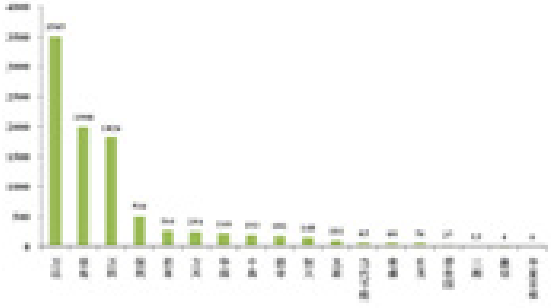


Fig. 2-1 Green Building Areas（unit: ten thousand m^2）of 18 Development Enterprises (2008-2014)

Chinese development enterprises work to improve the greenization level and quality of their products, guide firms at various levels to develop green products by formulating enterprise standards, gradually integrate green requirements into the product management procedures, mainstream green concept into the internal meaning of the products, highlight different technical features, and develop green building brands that demonstrate respective features.

We're committed to becoming a practitioner of the advanced living concept, advocating corporate social responsibility, and building livable green and environment-friendly ecological communities based on customer demands.

Mission of the China Urban Realty Association

The Explorations of CURA

China Urban Realty Association, a.k.a.CURA, was founded in 1999. It is an industrial strategic association jointly started by several most influential enterprises in the real estate industry, consisting of qualified developers in major Chinese cities, based on the principles of equality and mutual benefits. With 61 current member enterprises and projects in over 100 metropolitan cities in China, CURA has become an extremely influential industrial association.

CURA takes as its missions the visions of "becoming the practitioner of advanced human settlement ideas, promoting corporate social responsibilities, developing livable green environmentally friendly eco-communities based on customer needs". In the recent years, it has committed itself to promote green building development. Themed "For a Green Tomorrow", CURA made efforts to promulgate green ideas in various professional areas, and establishes the Green Professional Committee to conduct specialized study on green building development. CURA hosts an annual seminar on green buildings, while its member enterprises have increasingly devoted themselves to the development of green buildings.

After 14 years of practices and development, CURA has optimized advantages of various parties and realized mutual assistance and mutual benefits, by the four methods of information sharing, joint training, joint procurement as well as joint financing and investment.

CURA emphasizes that it is an organization of real estate developers with shared values, and that green environmentally friendly ideas are a core component to these shared values. In terms of real estate development, more than 90% of the member enterprises in CURA are making explorations on green buildings.

The Explorations of CURA

Over the years, the China Urban Realty Association has been committed to promoting the development of green buildings, and popularizing the green concept in various specific domains under the theme of "Imagining the Green Future". As a result, more and more members of the Association have devoted themselves into the development of green buildings.

China Vanke Co.Ltd. entered the real estate industry in 1988. It is currently one of the biggest housing development enterprises in China, as well as one of the first developers to answer the call of housing commercialization.

In 1999, the Several Opinions of Promoting Housing Industry Modernization and Enhancing Housing Quality document was issued in China, heralding the advent of housing commercialization. Vanke founded its building research center in the same year, and gradually established an institutional network among the group and the first-line local subsidiaries. Research and practical promotions were conducted from four aspects: design standardization, factory-based production process, on-site assembly and integration of the industrial chain. In 2007, Vanke launched the first industrialized project in Shanghai, which fully demonstrated the merits of industrialized construction. In 2008, Vanke added green development into its enterprise visions, solidifying the company's green strategy. In 2009, Vanke initiated its 3-step program to promote green strategy, the first of which was exquisite renovation, followed by housing commercialization and green buildings respectively. Starting from 2010, the mainstream Vanke housing products have been 100% fully renovated. Between 2008 and 2014, Vanke had completed an accumulated total industrialized building area of 28,620,000 square meters, and an accumulated total green building area of 33,690,000 square meters, of which 7,820,000 square meters were rated as 3-star green building areas, or 37% of the total 3-star green building areas in China. The HQ office building known as Vanke Center is not only 3-star rated by National Green Building Evaluation, but also a LEED-NC Platinum-level certified building.

Vanke signed an agreement with WWF in 2014, announcing its formal participation in the WWF Climate Saver program, thus became the first Climate Saver member enterprise in the global real estate industry. During 2013-2014, Vanke had accumulatively reduced greenhouse gas emissions of 1,092,000 tons of CO^2e. Vanke pledges that by 2018, it will develop a total of 49,000,000 square meters of housing with industrialized techniques, with no less than 13,500,000 square meters of new green building area, no fewer than 560,000 square meters of installation coverage for solar heating systems in new housing products, and estimated emission reduction of 5,300,000 tons of CO^2 equivalents.

Landsea Group Co.Ltd. was founded at the end of 2001. Landsea has been committed to green practices in real estate since 2004, and regards the development of green technology real estate, providing comfortable and healthy green energy-efficient housing to society as the company's development goals. For over a decade, Landsea has been focusing on green building development. It has established 10 scientific and technological systems for green housing, and built the first generation of green residences exemplified by the Nanjing Landsea International Street. Landsea then further developed

the second generation green residence products, also known as “1.5 liter residences” , which were launched simultaneously in Nanjing, Shanghai and Hangzhou on March 2011. Currently developments have begun for the third generation green residences“1 liter residences”. Landsea attaches great importance to technical innovation, and has intensified its research and development efforts through collaboration with high educational institutes, establishment of R&D bases, founding the Landsea Europe R&D GmbH, among others, ensuring that no lower than 2% of the group’s annual sales volume goes to scientific R&D. At the moment, Landsea is operating R&D bases in Jiangsu, Zhejiang and Hainan provinces, which take up the responsibilities of green building R&Ds, HR cultivation, experiments and tests of new technologies, information collection and analyses etc.. By now, Landsea has a total of 19 housing projects that were rated with the 3-star label, which is the highest level of certificate for green building designs by the Ministry of Housing and Urban-Rural Development. Between 2008 and 2014, the total area of projects with a green building label reached 1,810,000 square meters.

Modern Green Development Co. Ltd. was founded in 2000, who sets its development goal as “Constructing the most energy-efficient buildings and the coziest houses”. Beginning with the Wanguocheng MOMA project completed in 2005, the Modern Green takes green, energy-saving and ecological buildings as enterprise strategy, and realizes differentiated development by industrialized green operations. First, high quality is maximally secured from the design origins, whilst the emphases on the buildings’ energy efficiency, stable temperature and humidity as well as the quality of the buildings draw a substantial number of clients. In 2007, the Modern Green progressed farther, as it not only settled the energy consumption problem from a technical perspective, but also structurally solved the problem of ecologically sustainable development on integration of buildings and environment. The Modern Green continued to explore building solutions under different climates and resource conditions and launched the local MOMA residency. By far, the total area of energy-saving buildings developed by the Modern Green exceeds 4,000,000 square meters.

The China Urban Realty Association makes clear that it is an organization of real estate developers with shared values, and that green and environmental protection is part and parcel of the shared values. When it comes to real estate development, more than 90% development enterprises of the Association are exploring into green buildings.

Best Practical Cases

Vanke Center was completed and became operational in Oct.2009. The center has 6 above-ground floors and 3 underground floors, with a total height of 35m and total floor area of 16,600 square meters. Through general planning and individual building designs, Vanke Center not only maintains and protects the surrounding ecological environment, but also saves energy and encourages application and exploration efforts on new techniques and new materials under manageable budgets by taking full advantage of low-cost and low-investment approaches that utilize local green building materials and natural technologies. Meanwhile, it ensures physical and mental health of the office users inside the Vanke HQ as well as provides the coziness.

Land-saving and Outdoor Environment

It is the project's design idea to form "a horizontal ultra high building above maximized park scenery". It makes full use of

natural ventilation by adopting a hollow base design, which has no impacts on natural wind flows of the original ambient buildings but is advantageous for indoor ventilation.

The building's main facade spans across the direction of the dominant winds in the locality, which is favorable to form relatively significant pressure differences between the windward and leeward sides of the building. All the floors can keep 2-4Pa of pressure differences between the windward and leeward sides, enabling natural indoor ventilation.

Energy-saving and Utilization of Energy

Appropriate External Shading System.The main bodies of the external walls adopt 200mm autoclaved aerated concrete. The glass curtain walls use Low-E double silvering insulating glass. The facade is installed with adjustable sunshade systems made of aluminum alloy. The main body of the roof is made of 150mm reinforced concrete, whose thermal material utilizes 35mm XPS. The roof covering is also green.

Ice Storage Air Conditioning System. Given the climate conditions in Shenzhen area, Vanke Center only needs to consider cooling in summer. The air conditioning system employs the Partial Load Ice Storage System, whose designed storage capacity takes up about 44% of the designed daily cooling load of the air conditioner. Night-time running costs are lowered by making full use of the TOU pricing policy in Shenzhen. The wind system of the air conditioning uses a systematic form that combines underfloor air distribution, fresh air system and total heat recovery.

Solar PV and Building Integration. The Project's PV system is divided into grid-connected PV and Independent PV systems. The total installed capacity of grid-connected PV system is 272.7kWp, which is primarily used for underground parking illumination. Grid-connected PV power system can transform light into electricity at an efficiency of 10.05%, with a yearly total power generation of 276,800kWh. The yearly total power output of the independent solar PV system for the underground parking illumination is 5,100 kWh.

The total regular power consumption of the project in a whole year is 1,470,000 kWh(including light sockets, air conditioning and motors, excluding power used for temporary workings and special purposes). The power consumption for unit floor area stands at 88.6kWh/（m^2*a).

Water-saving and Utilization of Water Resources

The Constructed Wetland System integrated with the ambient scenery, and the Utilization of Reclaimed Water and Rainwater. A water recycling and purification system has been established for the lake. The area of the artificial lake is 3,000m^2, with a total water storage volume of 600m^3. The constructed wetland takes up an area of 200m^2. An ecological solution to curb the pollution called "The Vertical Flow Constructed Wetland Water Purification Technology" is being implemented, while hydrolysis acidification and contact oxidation are employed for the wetland pretreatment. The domestic sewage is used for local greenization, flushing & washing roads and squares, as well as water replenishment for the scenic lake after intensive recycling.

Rainwater Collection and Processing System. A maximum amount of permeable pavings are used to strengthen rainwater leakage, while at the same time the recycled rainwater is collected to reduce runoff discharge volume. The project buildings' roof coverage utilizes green coverage entirely, and the pavings mostly adopt gravel, permeable bricks, lawn bricks and the like for water

Star Label Rating:
China 3-Star Green Building Operation Label
LEED Platinum certification
Developer:
Vanke Group
Project Location:
Dameisha, Yantian District, Shenzhen
Project Honor:
Demonstration Project for Renewable Energy Building Application, Batch 4, awarded by Ministry of Finance and Ministry of Housing and Urban-Rural Development.

Vanke Center: Floating Green Horizontal Skyscraper

permeation. Total land use of the project reaches 61,730m^2, 88% of which are covered by permeable pavings. The precipitation collected via the roof coverage and outdoor water bodies is stored in the waterscape pool. The collected rainwater is subject to processing by the vertical flow constructed wetland before being used for greenization and road washing. The total consumption volume of reclaimed ***water*** and rainwater is 6760m^3, with the practical efficiency for non-traditional water sources hitting 46.3%.

Material-saving and Utilization of Material Resources

The project's construction widely employs renewable, fast growing and localized materials, in addition to poison-free, public damage-free and pollution-free building materials and renovation materials. Of these, 100% are green and 51.6% are localized.

Materials produced from wastes are adopted. The steel used includes 35% of scrap steel in the smelting stage, while the project consumed 1,500 tons of hollowed bricks, which contain 70% renewable concrete.

Fast growing materials are also used. All rooms' internal doors except the ones made of glass use bamboo, so do some of the floor tiles. Office tables and chairs are bamboo products too.

Quality of Indoor Environment

Setting up Indoor Air Quality Monitoring System. The fresh air unit and the total heat recovery fresh air ventilator can adjust air flow volume with variable frequency based on indoor CO^2 density, whilst the underfloor air distribution unit can automatically adjust air flow according to indoor temperatures.

Indoor Luminous Environment. The glass in use is Low-E double silvering insulating glass with high light transmittance, featuring a visible light transmittance of 0.67. Mobile adjustable external sunshade devices are deployed, which are built with holes for sunlight to get through in order to improve indoor lighting environment. By design, the project has a sunken garden with multiple lighting openings to enhance natural lighting effects in the basement.

Acoustic Environment: By introducing measures like insulating glass curtain walls, external sunshade devices, indoor sound absorption and noise alleviation, sound-proof building components, equipment noise reduction, among others, the equivalent sound pressures at all measured points are lower than 60dB(A).

Operation and Management

The building's intelligence system consists of the smart surveillance component (including building automation system, security & protection system, fire alarm and fire linkage control system and integrated management system for the building's equipment) , the information & network component (including generic cabling system, public broadcasting system, satellite and cable TV system, communication network system, data network system), other components (including digital conference and simultaneous interpretation system, parking management system, visual intercom and anti-theft system, lightning protection and earthing system etc.). Meanwhile, the building's energy consumption monitoring system, a comprehensive information network system and the building's equipment surveillance system have also been installed.

The property management company has established a relatively sound management mechanism for greenization and saving resources such as energy and water.

There is a 27m^2 domestic garbage collection station in the basement, where the collected wastes are sorted. Garbage sorting bins are placed in the office sector.

Best Practical Cases

Shenzhen Vanke City Phase IV: Green Community Practice with Adaptation to Local Conditions

Star Label Rating:
China 3-Star Green Building Design Label (Residential Buildings)
Awarding Time: Feb.2009
Developer: Vanke
Project Location:
Banxuegang High-Tech Zone, Bantian Street, Longgang District, Shenzhen
Project Honors:
Dec. 2005, Excellent Project of the Country's Top 10 Energy-Saving Projects Assessment;
2006, one of the three demonstration projects in the building industry, of the "Ten Key Energy-saving Projects of the Country", as well as the only "General Demonstration Project for Green Buildings".

The project covers an area of about 96,000 ㎡, with a total floor area of roughly 126,0m². Residences of both higher and lower floors, community amenities and a kindergarten are included. The research and practice efforts of the Shenzhen Vanke City phase IV's green community will always focus on customer needs, local features as well as its own practical experiences and technical capacity on green buildings, which will be combined with advanced green ideas both at home and abroad, and the development of green building technologies and related green building evaluation standards. In the principle of "Taking measures according to local conditions", the project is operating on six aspects of the green building evaluation system: land-saving, energy-saving, water-saving, material-saving, indoor environmental quality and operation &management, resulting in some creative technical feats in the South China region.

Energy-saving and Utilization of Energy

Through analyzing the impact on energy-saving by the ratio of reinforced concrete blocks against autoclaved aerated concrete blocks in the external walls of both higher and lower floors, a variety of measures are taken to enable over 60% energy-saving in the residences. These measures include: filler walls built with autoclaved aerated blocks and inorganic insulation mortar used in internal walls for the higher floors; self-insulation of autoclaved aerated blocks for the lower floors, combined with outer window sun-shading provided by adjustable aluminum alloy shutters; Meanwhile the window-wall ratio is well managed, and methods like using the Low-E glass etc. are taken.

Regarding the external sun-shading technique employing adjustable aluminum alloy shutters, the angle of the shutters can be adjusted according to needs, which has superb effects on room-based energy-saving, adjustment of lighting by customers, natural ventilation, room coziness and privacy.

The external sun-shading devices are designed to be integrated with the building. For the lower floors, combining the Spanish style and the design of household types, a good number of sun shading forms have been developed such as the adjustable casement shutters, the foldaway adjustable casement shutters, the sliding foldaway adjustable shutters, the balcony door-based sliding foldaway adjustable shutters, the upward-revolving adjustable shutters, the fixed adjustable shutters etc.. For the higher floors, the sun-shading devices are designed to be placed on the inner side of the balcony fence, greatly improving safety.

Water-saving and Utilization of Water Resources

The project gracefully combines rainwater collection, leakage and direct utilization. The natural gulches in Vanke City Phase IV are used to form ecological ditches and dry creeks, into which the clean rainwater from the flat roofs of

the higher levels, the sloped roofs of the lower levels and the lawns are diverted. The rainwater will then be subject to recycling and processing by the constructed wetland, constantly guaranteeing the surface water's Level 4 quality. Pools for water storage are built at the lowest points of the dry creeks, to be used for lawn watering, road washing etc. during sunny days. Water leakage is realized through measures like permeable road surface, lawn bricks at the outdoor parking zones, a relatively high level of greenization etc..

The reclaimed water technology uses biological contact oxidation and highly effective water cleansing techniques for vertical flow constructed wetland to ensure water safety; The reclaimed water is used for the watery scenery of Phase I and the water replenishment for Phase IV ecological ditches, watering plants, road sprays, washing of vehicle parkings and garbage house, with utilization level of reclaimed water hitting over 35%.

Material-saving and Utilization of Material Resources

The project offers property owners a comprehensive housing solution by adopting designs and construction that integrates earthwork and renovation. The water and power positioning in the kitchens, toilets and terraces, the installation positions of air conditioners, natural gas meters, water heaters and washing machines, the locations and quantities of sockets in bedrooms and living rooms, as well as the convenience, feasibility and beauty of housing spaces are all taken into consideration.

The indoor design professionals had engaged in the assessment of household types at the building design&planning stage. At the building design expansion stage, indoor design companies were tasked to deliver diagrams of water-power positioning conditions and diagrams of indoor building blocks' positioning conditions that fulfill design requirements for exquisite renovation to the building design institute. These were added to the final construction maps, by which the earthwork constructors began their work. All pipes and cables were buried and all holes were prepared preliminarily. After the contractors of exquisite renovation entered the site, there were generally no need for major adjustments to the cables, pipes and holes before the indoor renovation work commenced.

Wide-range applications are carried out with the inorganic insulation mortar used on inner walls in regions with hot summers and warm winters. Vanke and manufacturers jointly conducted argumentations and demonstrations on the thermal conductivity, contraction percentage, water proof capacity and other features of the inorganic insulation mortar, and built actual samples for proving, resulting in a manageable and comprehensive insulation technical solution.

Zero Energy Consumption Experimental Residence

The project envisions the construction of a zero energy consumption experimental building, which covers an area of about 400 m2 and has two above-ground floors plus one underground floor.

The research & development as well as practice of Vanke City Phase IV green community have been paying attention to customer demands, regional characteristics, its own experience and technical competence in green buildings, and working to take into account the leading green concept and green building technologies both at home and abroad, and the development of relevant green building evaluation standards. In light of the principle of "adaptation to local conditions", relevant work is conducted in six aspects of the green building evaluation system, i.e., land saving, energy saving, water saving, materials saving, interior environmental quality and operational management, gaining innovative technical achievements in southern part of China.

The experimental building of zero energy consumption aims at future development of residences, and is an improvement from the basis laid by Vanke City Phase IV's green building practices, running parallel to green residences of international high standards.

The project explores realization of experience-oriented, environmentally friendly, smart residences with ultra energy-saving or even zero energy consumption in regions with hot summers and cold winters. In the zero energy consumption experimental residence, intensified R&D efforts are conducted on multiple possible solutions to maintenance structures, renewable energy, natural ventilation, humidity reduction, sun shading, utilization of reclaimed water, green roof coverage, vertical greenization, indoor environmental quality and other aspects. Upon completion, the experimental building will become a platform for demonstrations, experiences and experiments in order to learn the customers' authentic feelings and needs, meanwhile serving as a technical breeding ground for large scale green building practices by Vanke.

Operation and Management

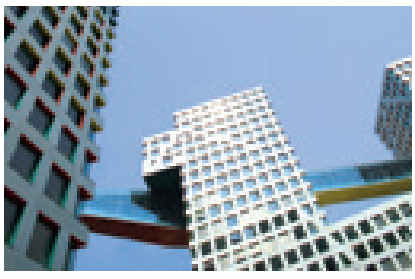
The marketing personnel have been engaged with the project since 2005 when the green buildings' technical plans were being designed, providing suggestions from the customers' points of view. At the project's sales in 2007, Vanke's green-themed quality experiencing venue was opened to the customers, demonstrating and popularizing the green building technologies used in the Vanke City Phase IV, such as eco-water environment, sun shading, solar water heating system, sound-proof slabs, intelligent systems etc.

Best Practical Cases

The Modernland MOMA's total area is 61,800m^2, while the total floor area is 221,400m^2. The 9 buildings in the community are interlinked by elevated corridors. There are 8 high-level residential tower buildings and 1 hotel, which are equipped with the community cultural center, an international kindergarten, underground parking zone and the elevated corridors. The project is highly appreciated by society and the property owners for its low-carbon green product ideas and the community development planning which is so rich in humane and metropolitan spirits. The Modernland MOMA is arguably a masterpiece, being not only the benchmark for Chinese low-carbon building industry and a role model for the real estate industry, but also one of the 10 Best Architectural Marvels by Time magazine of the United States.

Land-saving and Outdoor Environment

The project takes "urban integrated community" as its basic principle to plan and configure the community. The land used for project construction was originally the compound of Beijing First Papermaking Factory. It was among the urban renewal and development projects, with a high density of surrounding street blocks, convenient traffic conditions and sound urban utilities. As such, the community was mainly aimed at interaction and function supplementation with the ambient developed areas during the planning and configuration.



The community-based micro traffic system is highly developed. The pedestrians are separated from the vehicles, and a compact, suit-for-walking community street system has been designed.

The community by design has a cinema, a senior center, a coffee bar, a book bar, among other public amenities for the community dwellers' pleasure.

Energy-saving and Utilization of Energy

Highly effective outer thermal system for external walls, whose enclosure structure's thermal characteristics are consistent with European standards. In comparison, the yearly heating energy consumption for a household with 65% energy-saving is 8.82 kg standard coal/m2 by Beijing criteria, while the Modernland MOMA can save 28% of it.

Fine quality external windows and sun shades are used. The external windows adopt thermal Low-E silvered insulating glass filled with argon gas. The hidden frame design of the glass exposes no window frames to the outside air, completely eliminating any heat transfers brought by the thermal bridge.

The energy solution utilizes combined energy systems, which are dominated by a green energy system, the geothermal heat pump. This system provides heating and cooling loads to all residential units and public buildings in the northern sector except the basements, totaling about 5,000KW energy from 672 geothermal heat pump wells. When the loads provided by

MOMA is an architectural product featured by the integration of tech-themed real estate and international cultural theme from the environment to functions, from functions to forms, from forms to spaces, from spaces to culture, and from culture to technology and philosophy. All contributes to the great achievements of this architectural product in light, shadow, affection, situation and the landscape.

by Zhang Lei, chairman of Modern Land (China)

Contemporary MOMA: Role Model of Green and Eco-Community

Star Label Rating:
China 3-Star Green Building Operation Label
Developer:
Modern Green Development Co.Ltd.
Project Location:
Courtyard No.1, Xiangheyuan Street, Doncheng District, Beijing
Project Honors
2005: China's New Architectural Wonders by Businessweek;
2006: the World's 7 Best Construction Projects by Popular Science;
2007: the 10 Best Architectural Marvels by Time;
2008: the Annual Sustainable Building Award by American Institute of Architects, New York Chapter;
2009: the International Best Tall Building Award by CTBUH (Council on Tall Buildings and Urban Habitat);
2011: LEED-ND Phase III certified.

the geothermal heat pump system are running short of demands, the hot-water gas boilers and cooling tower systems are used for peak adjustments in winters and summers.

The terminal side employs the ceiling radiation system, which can guarantee even radiation of heating and cooling, thus enhancing indoor coziness.

Water-saving and Utilization of Water Resources

Within the Modernland MOMA , there is a reclaimed water processing station. All qualified exhaust water from the residential units will be collected at the station for processing, and subsequently are used for toilet flushing, community scenery, water replenishment for the cooling towers in summer etc..

The rainwater station is set up beneath the green garden's hills in the northern sector, which collects rainwater in summer for watering plants and scenic water replenishment. Its initial discarding pool has a volume of 330m^3, the volume of the rainwater storage pool is 2552m^3, the clean water storage pool is 458m3, the rainwater processing and water resupply machine room is 268m^3. The total land area of the pools and the machine room is 669m^2. The rainwater can be processed at 20m^3/h.

Material-saving and Utilization of Material Resources

New materials are used to build the walls. The external walls of the project use 100mm XPS boards for outer heat insulation. The roof coverage utilize 200mm EPS boards, while the indoor separation walls use ceramisite concrete blocks and light steel keel plaster boards. As the Modernland MOMA utilizes the framed tube structure, with steel-structured elevated corridors linking different buildings, the usage of high strength steel bars takes up 93% of the total steel bar usage, far exceeding 70%.

In the design and procurement phases, recyclable materials were abundantly used, such as steel, aluminum alloy, lumber, plaster etc, so that the environmental impact could be maximally lowered. The recyclable materials took up 15.3% of the total weight of the building materials. Most materials for the project were procured from Beijing suburbs. 81.2% total weight of the building materials was bought within 500km from the construction site.

Indoor Environmental Quality

The adjustable fresh air exchange system is adopted. The inflow fresh air after centralized processing can be exchanged with the stale air effectively. All fresh air units are equipped with high-efficiency plate total heat recovery machines, and there is no cross contamination between fresh and stale air.

In-room sound-proof design, with the slabs arranged in floating floors, the interlayer noises can be isolated effectively.

Landsea • Zhongshan Lvjun: Scientific Residential Housing

Star Label Rating:
3-Star Green Building Design Label（Residential Buildings）
Developer:
Nanjing Landsea Green Properties Co.Ltd.
Project Location:
Maqundazhuang No.5, Qixia District, Nanjing

The Landsea Zhongshan Greenshire covers 97,398m2 of total land area, with a total floor area of 168,953.58m2. The whole project consists of twenty 6-story residential buildings, seventeen 3-story residential buildings, two 3-story commercial buildings plus some public auxiliary buildings and underground parking. The project is another masterpiece of the Landsea Group after many years of hard work in the green building area. Not only does the site selection reflect the zenith of living coziness in Nanjing, but significant technical breakthroughs have also been achieved in the areas of health, comforts, humane spirits, green living etc. Altogether 10 advanced green building systems are utilized here, including the geothermal heat pump system, the ceiling radiation cooling & heating system, the independent temperature-humidity control air conditioning system, the highly effective energy-saving illumination system, the same-level toilet drainage system, among others. Therefore, it is acclaimed as “2nd Generation Product of Green Human Habitat” by industrial counterparts.

Land-saving and Outdoor Environment

The Zhonshan Greenshire faces the south, which satisfies the need on building facade directions in regions with hot summers and cold winters. The buildings’ enclosure structures mainly use 100mm EPS for heat insulation. The external windows utilize insulating glass, which are satisfyingly sound-proof.

The project’s greenization percentage is 38.6%, and the outdoor permeable land surface takes up 60% of the total area. The sizable greenbelt area and the permeable pavings can effectively neutralize the urban heat island effect.

The project develops the underground space reasonably. Beneath the surface are located the parking zone, the rainwater processing machine room, the geothermal heat pump machine room, the transformer substation and others. The underground floor area totals 19,103.47m^2, and the ratio of underground floor area against the buildings’ land area is 2.3:1.

Energy-saving and Utilization of Energy

The main bodies of the buildings are designed to be energy efficient. The enclosure structures of the project’s various components all have energy-saving designs, with the buildings’ shape coefficients, window to wall ratios and the heat transfer coefficients staying below the limitations set by the standards.

The primary external walls rely on 100mm EPS for heat insulation. The roofs have 70mm rigid polyurethane foam boards for the same purpose. As for the outer windows, those in the main rooms resort to 5 high photopermeable Low-E+15 air + 5 transparent - plastic window frames, while those in the secondary rooms utilize 5 low photopermeable Low-E + 15 air + 5 transparent - plastic window frames.

Highly energy-efficient air conditioning system and equipment. The geothermal heat pump-based central air conditioning system is adopted, with the ceiling radiation-fresh air exchange system installed at the terminals. The terminals of the radiation system provides a high level of comforts. The unit’s efficiency is effectively enhanced by using cold water under high temperatures and hot water under low temperatures, resulting in energy-saving. The fresh air system has enthalpy recovery wheels that reduces energy consumption on fresh air processing.

The elevators use gearless tractors propelled by PM electric motors of excellent performance,

enabling efficiently lowered power consumption.

The highly efficient energy-saving illumination system. All illumination sources, barring those with renovation requirements, are equipped with rare earth RGB energy-saving fluorescent lamps, T8(T5) tubes, electric ballasts (all with VAR compensator, power factor >0.9). Ra≥80. Indoor open lamps' efficiency >75%, the other lamps' efficiency >70%. Lamps used for illumination in public corridors and stairwells (except lobbies and lift halls) employ sound and light control switches. Public lighting and other public power-consuming devices use independent meters, the specifications of which are regulated by utility departments.

The utilization of renewable energy. The Zhongshan Greenshire resorts to the geothermal heat pump-based central air conditioning system, which uses earth and atmospheric cooling towers as cold and heat sources. There are 4 geothermal heat pump units and 2 cooling units to provide cold and heat to the terminal ceiling radiation and fresh air systems. The fresh air systems are provided with chilled water of 7^{O}C ~ 12 ^{O}C in summer by the heat pump units and cooling units, or hot water of 30^{O}C ~ 35^{O}C in winter by the heat pump units. The switch of working modes during different seasons is realized by change of valves. The two atmospheric cooling towers can be activated in real time according to the operational status of the heat pump systems and the surveillance readings of underground temperature. In summer operations, they can supplement heat extraction by the buried pipeline system to ensure underground heat field equilibrium and avoid accumulation of heat or cold.

Water-saving and Utilization of Water Resources

The planning and design of the buildings' water supply and drainage systems must comply with the Design Standards for Buildings' Water Supply and Drainage (GB 50015) and other standards. Water meters are type-based, water consumptions from the buildings and the scenic watering&irrigation etc. have their own meters for independent calculations.

The bathrooms of the project are installed with sanitary fittings, lavatories and closestools, all of which have water-saving product certificate. Meanwhile, leakage-induced losses in the pipe network is effectively alleviated by using alloy materials and pipe connection method.

The scenic greenbelt watering introduces a complex irrigation approach that combines automatic sprinkling irrigation and manual quick coupling valves, mainly using TORO V-1550 series buried rotating nozzles. The nozzles have long range and adjustable angles. Management is exerted by regions and time periods based on greenbelt distributions, primarily by PEB series electromagnetic valves on the regional pipe branches and the program controllers in the control boxes.

Utilization of non-traditional water sources. Rainwater is recycled and utilized from roofs, hard surface and greenbelts. The total area available for rainwater collection is 32,167m^2, with underground rainwater processing structures. The collected rainwater goes through the desilter, conditioning tank, sedimentation tank, coarse filter and the distribution reservoir before going into the machine room for chemical processing. The final stage is the clean water tank, where the rainwater is elevated by pumps for the greenbelts, road washing and scenic water needs.

The annual quantity of collected rainwater is 12,930m^3. The collected rainwater after processing is used in greenbelts, washing of roads and squares, as well as water replenishment for sceneries. The conditioning tank has valid volume of 275 m^3. The usage of rainwater hits 9,670 m^3/year based on calculation of monthly equilibrium of precipitation. This means the utilization ratio of non-traditional water sources reaches 12.98%. If calculated by rainwater collection volume of the assessed buildings, the utilization ratio of non-traditional water sources is10.80%.

The rainwater permeation. The area of outdoor land surface is14,989.74m^2, and the area of permeable surface, i.e. green surface is 8,993.41m^2. The project has a sizable greenbelt area that can efficiently store rainwater and collect rainwater from the entire community, so as to make full use of rainwater and increase earth humidity, resulting in improved local climate.

Material-saving and Utilization of Material Resources

The Zhongshan Greenshire uses ready-mixed concrete to reduce sound and dust pollutions at the construction sites, and save energy, resources and materials.

The renewable materials include steel, timber, PVC, plaster products and glass. The total weight of building materials is 110,880.638t, of which 11,190.998t are renewable materials. The weight of the renewable materials makes up 10.1% of the total weight of buildings materials. Furthermore, the project makes use of high-strength steel to solve the "big beams, huge pillars" problem in the buildings' structures, thus increasing the usable area of the buildings. This method enjoys prominent advantages in terms of endurance and material saving.

The earthworks and renovations were designed and conducted in an integrated manner. By early completion of designs for the professional programs, the pre-

cast and preliminary handling are successfully achieved. If there is any adjustment, communications are to be made timely for changes and corrections. The various departments devised their respective technical plans in the principle of green construction and based on their own features. The plans were used to guide construction efforts, successfully avoiding collateral damages by demolitions and repeated renovations.

Indoor Environmental Quality

The lighting effects in main indoor functional spaces are satisfying. The lighting coefficient is generally at over 1.1%, while that of the restaurant basically stays above 0.55%. The holistic figure is roughly 99.78%.

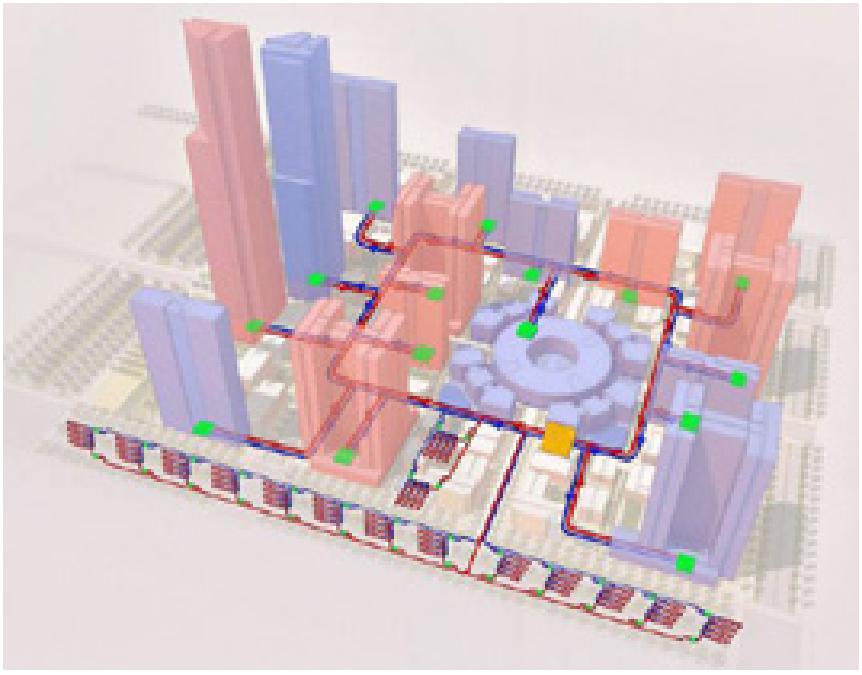
Natural ventilation. Through analyses on the flow fields and wind speeds in type A, type B and type C units of the Zhongshan Greenshire Garden, as well as by calculation of times of indoor natural ventilation and air replenishment, it is concluded that the main functional rooms' vent opening areas are proportionally sound to the floor areas in these unit types, and that there are more than 10 times of air replenishment per hour in the aforementioned rooms.

Operation and Management

Management mechanisms have been established for energy-saving, water-saving, consumables and greenization efforts, while incentives are introduced to manage resources. The water, power and gas supply are subdivided to each and every residential unit for category-based counting and charging.

Application of intelligent systems has met the basic configuration requirements in the Systematic Configuration and Technical Requirements for Intelligent Systems in Residential Areas. Established intelligent systems include the Patrol Management System, the Information Network System, the Vehicle Entry, Exit and Parking Management System etc..

Yongxin Commercial Real Estate Project, Chenggong New District, Kunming



The project is located in the downtown of Chenggong New City in Kunming. The total investment reached CNY 4,800,000,000, with a total floor area of 700,000m^2. The project demonstrates dense and cross-type land usage, as well as pedestrian-friendly and public traffic-oriented development mode. It genuinely displays enhancements in quality of life due to easy access (i.e. within walking distance) to various services, recreation and transport facilities. Thermal walls, geothermal heat pumps, reclaimed water processing, 3-Dimensional green system, green ecology and knowledge network are all used to build a low-carbon, environmentally friendly, comfort and ecological project of knowledge, whereby the environment is improved and quality of life gets elevated. A vivid and exciting space is thus created.

Innovative Traffic Design

-More delicate road network and smaller street blocks

Based on the new TOD planning that values fine grid road networks and humanely designed blocks, this land parcel has been redivided into 9 blocks from the 4 original blocks. It is expected to display small blocks-based city structures, as well as to promote travel by walking and cycling and diminish reliance on vehicles, providing a small blocks-based TOD mode for China.

- More space for development

There are substantial resources of public traffic in the land parcel. The land use is mixed, so there is more space for development.

- Streets dedicated to non-motor traffic

Two streets are planned to be dedicated to non-motor traffic, where only walking and cycling are allowed, bring further improvement to walking and cycling environment under the system of small blocks. These non-motor traffic streets are a part of a greater non-motor traffic system. The streets are public in nature, and they can be extended to other blocks, so that a continuous walking and cycling route can be provided, granting access to citizens outside.

- Higher level of crossover land usage

In the sustainable design, a mode that endorses crossover usage of land is introduced. 40% area of the development region is reserved for residential-style SOHO. There are more occasions suitable for walking or cycling. These localized traffic forms are the most economic traffic energy-saving method currently in existence. They can also provide supplementary health benefits.

- Greater building land area (building density)

The building density in the land parcel will be somewhere between 55% and 70% by planning, with sizable reservations for greenbelts.

- Shorter setback distances for the buildings

If the setback distances of the buildings are too long, they will hamper interaction between buildings and the street, resulting in suppressive urban space and impaired habitability. Based on the municipal technical standards of Kunming, the required setback distances of the buildings are considerable.

The downtown TOD planning has been ratified by the government to become a test field for new ideas. It is no longer bound by the limitations imposed in local technical standards regarding the buildings' setback distances. The new design substantially shortens the buildings' setback distances on the basis of the original plannings. Not only the setback distances on Caiyun Street are shortened, the minimal setback distances on other streets have also been limited to less than 10m.

- Enhancing walkability by building line control

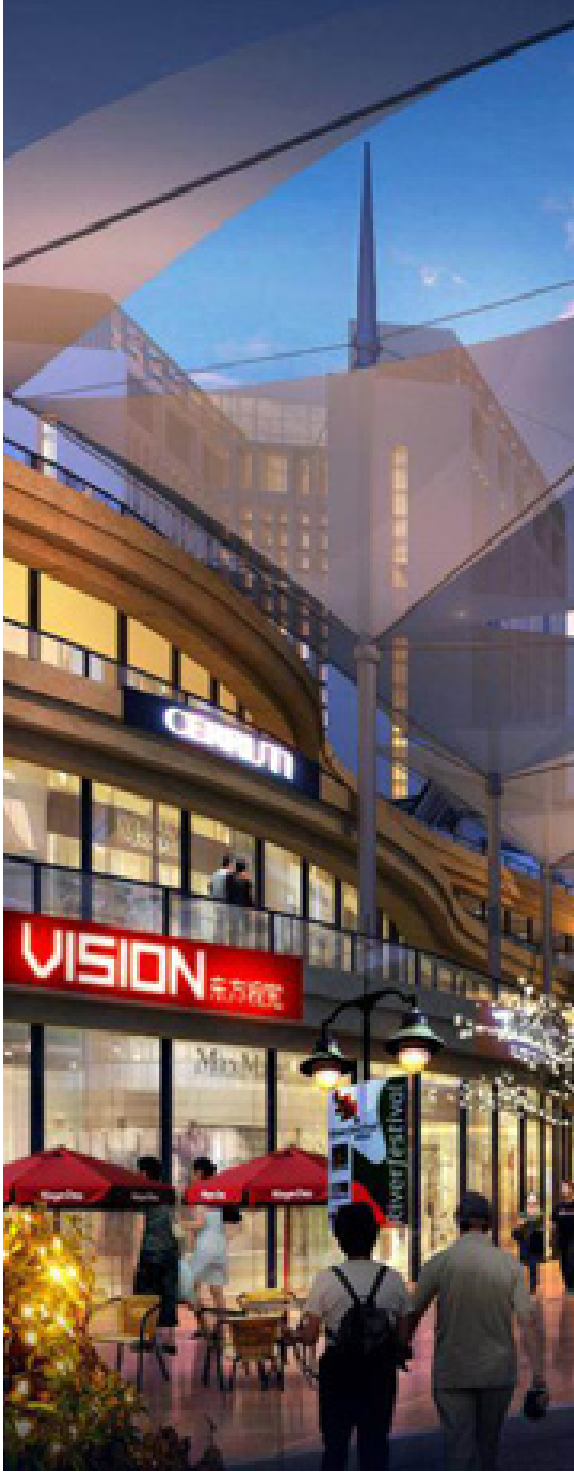
A certain proportion of building lines need to be placed closely next to the buildings' setback redlines. On west-to-east streets, the proportion is set at 70%-90%, whereas on south-to-north streets, it is set at 65%-85%. The distance between buildings and sidewalks on each street get shorter, therefore prevents turning setback zones into parking zones. It is estimated that this method can increase the number of pedestrians and improve the vigor of the streets.

- Less parking spaces

All parking zones are placed underground. The number of parking spaces has decreased by 50%, down from 1-1.2 parking space/100m^2 of floor area to 0.2 parking space/100m2 of floor area, which leaves more of the limited surface space to pedestrians.

- Improved public traffic

The land parcel lies close to two planned express bus lines and is also near two subway stations. One of the stations is 630m from the center of the land parcel, being completed and operational. The other is still in the planning stage, located 880m away from the center of the land parcel.



Energy-saving and Utilization of Energy

The design utilizes high-performance building skin strategy. The superb insulating glass, heat insulating slabs and sun-shade devices are usually able to enjoy advantages brought by other strategies concerning the dimensions of streets and buildings in the most economic manner. The optimization of curtain wall designs is considered as the primary motion for optimization. It can create an enormous optimizing

Star Label Rating:
Phase I Development ongoing. All buildings meet China Green Building 1-Star Standard. In the future phases, all buildings will meet above 2-Star Standards.
Developer:
Jiangsu Yongxin Group
Key Associated Parties:
Energy Foundation, Kunming Urban Planning Bureau
Project Location:
the Intersection of Juxian Street and Caiyun South Street, Chenggong New District, Kunming, Yunnan Province

effect on other ecological energy-saving strategies, greatly elevating efficiency in other systems.

The geothermal and radiation heating/cooling strategy. Given the mild climate in the Chenggong New District, geothermal system is an ideal form of energy for heating and cooling.

The central control room. Establishing a central control room system for a project of this size is beneficial to lower initial investment on controlling equipment. By projections, this strategy can save energy by 35%, thus increasing operational efficiency. The central control room can also provide maximized flexibility for future expansions and renewals or updates of new technologies.

Best Practical Cases

SunnyWorld Alpha Int. Community, Nanchang—Practice on Green Buildings

Developer:
Tsingtau SunnyWorld Group Co.Ltd.
Project Location:
Hongjiaozhou Ecological School District, Honggutan New District, Nanchang, Jiangxi Province
Project Honors:
The sole "Demonstration Project on Renewable Energy-Residential Buildings" in Jiangxi Province
The first project in Jiangxi province to be included into the "Forbes' Choice-2009 Role Models for Green Human Habitat"

The SunnyWorld Alpha International Community is the primary human habitat project of the SunnyWorld Group in Nanchang. It covers an area of 114,000m^2, with total floor area 397,700m^2. The project fully adopts a low-carbon technology-guided development mode, perfectly integrating the idea of green human habitat into metropolitan ways of life. Besides providing sound living functions, the project emphasizes enhancement of living coziness and excellent combination of outdoor scenery and indoor space. It aims at establishment of an international residential community for the high-level customers in Nanchang, which can jointly utilize multiple building-based energy saving techniques in the aspects of thermal energy saving, winter heating, summer cooling etc. and provide qualified, customer-friendly property management service with highly comfortable exquisite renovation solutions.

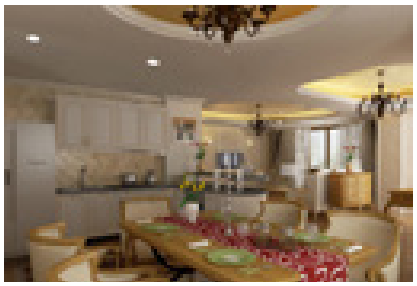
Energy-saving and Utilization of Energy

The project uses water source heat pump units with heating coefficient of performance at over 5.0 and cooling coefficient of performance at over 7.0. The effects on environmental protection are notable, as the smoke exhausted from the boilers is prevented from contaminating the machines, while noises and molds are avoided altogether because the need on cooling towers for cooling is removed. The renewable energy stored beneath the earth can be fully utilized too. The water source heat pump-based central air conditioning system has a per unit efficiency of 6.8 by COP value in summer, with the system's COP reaching 3.66, whereas the per unit efficiency in winter is 5.2 by COP value, with the system's COP at 3.93. The shallow underground water source heat pump system's air conditioning units have a comprehensive energy efficiency of 3.8.

The heat insulation system on external walls consists of three major outdoor insulation

subsystems: external wall insulation, roof insulation and partial ground insulation on the ground floor. The materials' thickness is 2~3 times that of ordinary materials. Under natural conditions, these have a lower water absorption rate, therefore ensure long-term and steady heat insulation and heat proof characteristics. The insulation materials on the external walls are 70mm thick polystyrene insulation boards, with wall heat transfer coefficient K=0.54 W/(m^2•k). The insulation materials on the roofs are 100mm thick XPS boards, with roof heat transfer coefficient K=0.29W/(m^2•k). The ground insulation materials on the ground floor are 50mm thick XPS boards, with ground heat transfer coefficient K=0.4 W/(m^2•k).

The external sun-shading system employs rewindable metal curtains, with a sun shading



efficiency of 97%. It has several functions such as heat proof, radiation protection, thermal insulation, energy saving, noise mitigation etc., and is able to avoid direct sun light at maximal extent. While stopping the dazzling light, it also maximizes the use of natural light to ensure even distribution of indoor lighting.

Water-saving and Utilization of Water Resources

The SunnyWorld Alpha International Community provides a nutritious water generator for each and every residential unit, which serves drinking water directly. It can eradicate solid sediments, oxidating agents, foul smells, organic substances etc. from water at high efficiency.

Material-saving and Utilization of Material Resources

The project uses qualified PVC doors and windows, which have much better performance than others in the regards of energy saving and improving indoor heat environment.

Low-E insulating glass. By gilding membrane-like products consists of multiple layers of metals or other chemical compounds on the glass surfaces, the glass' gilt membrane layers are given with the features of low radiation and high photopermeability. As a result, the heat exchange between indoor and outdoor spaces caused by radiation is alleviated. There is certain hollow space kept between the two layers of glass, which is filled with argon, enabling excellent thermal, heat-proof and sound-proof qualities, among other features.

Indoor Environmental Quality

The heat recovery fresh air system is installed, with heat recovery efficiency at 67%. The fresh air system's air blowing and exhausting are conducted by a single unit of heat recovery ventilator. The ventilator blows fresh air from one side of the room, while exhaust stale air from the other side, taking in fresh air at the same time of removing pollutants. The dwellers can enjoy fresh air from the nature without opening windows, thus effectively avoiding molding problem on furnitures and clothes. It can also adjust indoor humidity and save heating costs. It is equipped with heat energy recovery system, which can prevent excessive energy loss due to the ventilation process.

Kitchen leftover processors are set up in the community, which smash small bones, eggshells, vegetable leaves, fruit peelings, coffee dregs and other food leftovers into ultra tiny particles to be sent to the sewers by water. They can eliminate or reduce odors and harmful gasses released from rotting garbage, and inhibit growth of bacteria on a long-term basis, making the air in the kitchens healthier.

The project is composed of residential buildings with complete renovation, which decreases waste of materials due to repeated renovations. Environmentally friendly materials are extensively present in the materials used in the complete renovation. Factory-based production and on-site installations reduce building wastes, and eradicate harmful gasses such as formaldehyde. Presence of building wastes is over 90% less than that of the pre-renovation buildings.

International Cases

Portland

Portland is home to diversified "20-minute green blocks" and the bicycle and transit-oriented transport system. Portland carries out highly intensive development within the Urban Growth Boundary and creates economic benefits with green design, all making it a role model of modern eco-cities.

For long, Portland has been committed to sustainable urban development, and the "Urban Growth Boundary" policy pioneered by Portland has successfully controlled urban sprawl; the transit-oriented development (TOD) mode has secured the balanced development of the urban traffic network; the strategy for intensive and diversified "green blocks" has helped create efficient, green and sustainable communities that are suitable for walking and full of economic vitality.

Restrict vicious urban expansion -- "Urban Growth Boundary" policy

After the end of the Second World War, the United States has witnessed the massive development of suburban areas. As a result, "suburbanization" has emerged as a new regional economic and social phenomenon, and the expansion of expressways and private cars have provided technical support. That said, the laissez-faire urban sprawl has invited many issues, including the inefficient utilization of public facilities. In 1979, the Oregon Parliament rolled out the world-renowned Urban Growth Boundary policy across the State. Urban Growth Boundary refers to an expected urban growth boundary. Within the Boundary are current urban boundary and land reserved for the city to meet future growth demands; beyond the Boundary are croplands on which urban development and construction of small new towns are prohibited. The policy urges cities to conduct intensive and high-density development within the specified boundary. Each year, only slight outward land expansion is allowed. In the past more than 4 decades, Portland has developed in strict accordance with the specified Urban Growth Boundary, and successfully controlled urban sprawl. This policy has protected agricultural and forest land, enhanced high-density development and the development of available space of old towns, and also facilitated the efficient land use. Up until now, the Urban Growth Boundary policy has still been one of the most comprehensive planning regulations in the US history.

Transit-oriented development mode

A perfect traffic system is a necessary factor for controlling urban sprawl. The transit-oriented development (TOD) mode represents the greatest highlight of Portland's urban planning as it has ensured the efficient and intensive development of urban construction, and reduced private car use based on the shape and texture of urban spaces. The public transit system of Portland includes buses, light rails, tramcars, commuting subways and cable cars. Portland takes the stations of rail transits as the center of urban development. While trying to develop pedestrian-friendly neighborhood spaces, Portland has utilized the public transit system to make neighborhood walking and trip to workplace more convenient. In the meantime, Portland has also expanded the transport network, and carried out high-density mixed development by centering on public transit nodes, so as to ensure the efficient utilization of infrastructure. It has developed multiple functions, including office, commerce and residence, to ensure that people can access to comprehensive basic service facilities within walking distance. For that matter, the urban planning authority of Portland has put forward the concept of "20-minute communities", which ensures that anything required in daily lives can be met within 20 minutes of walking distance.

In addition, Portland also has a driving network with perfect systems. Committed to the balanced development of the traffic network, Portland has tried to promote the development of the public transit network via bicycle. To that end, Portland has taken a host of measures, including setting up bicycle parking lots on all crossroads. It has broadened sidewalks on some bridges, and provided bicycle repair and rental services as well as free bicycle maps in bicycle parking lots and stores. These policies have enabled Portland to have the longest bicycle lanes (more than 500km) and the highest rate of cycling trip (about 8%) in the US. Large-scale cycling trip for commuting purpose has also produced considerable economic benefits. Studies show that the bicycle industry has contributed more than US$60 million to the local economy. As commuting by bicycle has become very popular, many enterprises have worked with the city to gradually change motor vehicle parking lots to bicycle parking lots.

High-density and diversified green community planning

Apart from urban planning and transport policies, Portland has been implementing the "3D principle" (Density, Diversity and Design, i.e., green design with density and diversity) in urban construction. It has tried to plan and build efficient and green sustainable communities that are suitable for walking and full of economic vitality by centering on urban public transit nodes.

Green building is also one of the defining features of Portland. As things stand, Portland is the city with the most per capita LEED-certified green buildings in the US, including the Portland movie theater project transformed from the hangar of the US Air Force and Portland Harbor Center for Architecture. Besides, Portland is vigorously promoting zero energy and water-consuming "living building". It has also expanded the concept of green building into "green blocks", with a view to integrate the best resources including green building, urban design, and transportation on the scale of several blocks. Green technologies cover the circulation of recycled water, rainwater management, and community-level cool-heat-electricity cogeneration, agriculture and selection of multi-mode combined transport. It is because of the high degree of mixing of urban spatial patterns -- blocks "in use 24 hours a day" that makes community-level energy integration possible.

Portland's attention and effort to green ecology have facilitated the sustainable socio-economic development. The purpose of Portland's "economic development strategy" is centered on clean technologies and clean energy, with a view to create 10,000 new jobs within five years, such as the design headquarters of Intel, Nike, and the headquarters of Vestas (the world's largest wind turbine manufacturer). On top of that, the policy supports of Portland for the educational and creativity industries have attracted hundreds of small design and creative businesses. The said two industrial modes have created many green jobs for local people. The past decade was a decade with the worst economic performance in the US, but Portland has kept 2% of average annual growth rate.

Revelation

As the "Green City" of the US, Portland has offered many referential planning strategies for Chinese cities, and its continuous practice of the TOD mode and sustainable urban development concept has ensured the maximum utilization of urban transport and energy efficiency, created vigorous and livable streets, convenient and diversified urban atmosphere, and injected vigor and vitality into the economy.

International Cases

The application of the BIM software enables seamless information sharing and collaboration between different fields and stakeholders by fully supporting the following process: Engineering and design （including conflict resolution, design coordination, RFI system and working drawing）; Project control and planning （including study of earned value and 4D）; Contract and quantity surveying（including calculation of work load）; Manufacturing（including digitized manufacturing）; Actual construction and work delivery （facility management）and Other fields （including inter-station logistics, temporary installation,scaffold and formwork）.

The BIM drived process effectively accelerated the delivery of the project throughout the entire project period, which eventually minimized risks and ensured the successful completion of the project.

Abu Dhabi International Airport Terminal

Location:
Emirate of Abu Dhabi
Scale:
Covering an area of 7 million square feet.
Design institute:
KPF and Arup, NACO, and BNP Associates.

Case Summary and Revelation

After more than a decade of practice and exploration, Chinese urban development enterprises have built up lots of excellent and high-grade green buildings, made outstanding achievements in the technologies for land conservation, external wall insulation, energy saving, utilization of renewable energy, water and materials conservation, recycling materials, and interior environment quality, and accumulated rich experience in constructing green buildings, as they steer themselves towards the direction of covering the entire process of planning, construction and operation, different regions and types.

Relatively speaking, some international construction projects have emphasized more on the application of TOD, community construction, BIM and other smart measures. And these international practices are beneficial for improving the quality of dwelling environment, saving energy and reducing carbon emission across the board. Therefore, TOD, green communities and BIM smart management will become the major areas Chinese urban development enterprises shall improve as they seek to explore into a green and low-carbon development road that is suitable for China's development features and stage.

Carbon emission peak will be realized in China in 2030: low-carbon development goals of urban development enterprises.

As the policy goals for global climate change action, China has made clear that carbon emission is expected to reach the peak value around 2030, and China will increase the proportion of non-fossil energy in primary energy to 20% in 2030. In the meantime, the Enhanced Actions on Climate Change: China's Intended Nationally Determined Contributions submitted by China to the Secretariat of the United Nations Framework Convention on Climate Change indicated that by 2030, the carbon dioxide emission per unit of GDP will be 60%-65% lower than that in 2005, the share of non-fossil energy in primary energy consumption will reach about 20%, and forest growing stock will see an increase of about 4.5 billion m^3 from that in 2005. The national objectives proposed by China will play a decisive role in the Paris Climate Change Conference.

As China embarks on the road to reaching the carbon emission peak, the major goal is to reduce the emission of urban construction and relevant activities. Cities will be the major source of emission growth in the future. Currently, the total emission of transportation, construction and other sectors accounts for nearly 30% of the total emission and has already exceeded 2.1 billion tons, which will keep rising down the line. By 2030, China's urbanization rate will generally reach 68%-72%; as urbanization level increases by 1 percentage point, carbon dioxide emission will grow by about 200 million tons in transportation, construction and other sectors. This means that China's urban construction is more likely to increase at least about 4 billion tons of emission, so it's necessary to establish an innovative mode on the urban construction development model so as to reach emission peak before 2030. The investment, construction and operation behaviors of urban development enterprises during the process of urban development have provided an important market platform for reducing greenhouse gas emission during China's urbanization drive. Urban development enterprises need to promote the development of low-carbon real estate industry, give play to market functions and advantages, and assume the social responsibility for controlling carbon emission of China and the world as a whole.

Part 3 Strategy for Addressing Global Climate Change:

Development Goals and Principles of Chinese Urban Development Enterprises

1.Vigorously Promote Green Buildings

The designed architectural energy saving standard is more than 5% higher than the local architectural energy saving standard.

The 24-hour average PM 2.5 concentration limit should be no higher than 35 μg/m^3.

More than 10% (in weight) of the construction materials are recycled materials.

More than 80% (in weight) of the construction materials are within 500 km of the construction site.

The material part of cities are mainly composed of buildings, and as the total number of buildings increases constantly and residential comfort level improves, building energy consumption has been on the rise. To build low-carbon and livable urban spaces, the developers shall focus on various segments, including architectural design, construction, and operational management, so as to not only accommodate people's requirements for comfort level, but also save and utilize energy in an effective way, and reduce carbon emissions, thereby facilitating China to realize the goal of reaching carbon emission peak in 2030.

Green building refers to a building that saves resources (energy, land, and water as well as materials), protects the environment and reduces pollution in a maximum way, provides a healthy, suitable and efficient space for people, and realizes a harmonious coexistence with the nature throughout its full life-cycle. Green building tries to reduce its environmental impacts and carbon emissions in every segment, ranging from design, construction to maintenance.

1.1 Adopt green design across the board

China is a vast country, and its regions differs each other in climate, resources, natural environment, economic level, and cultural conventions. Regional disparity and different functions of various types of buildings have determined that the routes of green design might be in endless variety. As such, the first essence of green design lies in "adjusting measures to local conditions".

Adopt low-energy design with high standards: adjust measures to local conditions, enhance passive and low energy consumption design, fully utilize on local natural conditions, such as sunlight, wind power, temperature, humidity, terrain and plants, employ natural lighting, natural ventilation, sun-shading, thermal storage, rainfall penetration and other measures, improve the environmental

adaptation of the architecture and reduce environmental impacts; preferentially select exterior wall with self-insulation system when it comes to the heat insulation design of enclosure structure of exterior wall; optimize the architecture energy solutions, design the renewable energy system in a rational way, cut back on the utilization of fossil fuel, and reduce pollutant emissions. All of these measures contribute to the fact that the designed energy-saving standard of a green building is over 5% better than local energy-saving standards.

Improve the quality of indoor environment: apply appropriate technologies and strategies to improve the air environment, thermal environment, acoustic environment, light environment, water environment, electrical environment and landscape environment of residence spaces in a comprehensive way. Therefore, the following goals are realized: primary air system is equipped with such functions as air purification, temperature and humidity regulation, the average wind speed of interior fresh air lives up to human comfort level, and the concentration of carbon dioxide is controlled in an intelligent way; the concentrations of indoor free formaldehyde, benzene, ammonia, radon, TOVC (total volatile organic compound), and other air pollutants meet the provisions of the existing national standard -- the Code for Indoor Environmental Pollution Control of Civil Buildings (GB-50325); the concentration of PM2.5 meets the target of the code of the World Health Organization (24-hour average concentration limit is no higher than 35 ug/m3, far below China's air quality standard for general residences of PM2.5, i.e., lower than 75 ug/m3); and the lighting system uses energy-saving lamps and lanterns, and the illuminance meets the different demands of the users.

1.2 Strictly implement green construction management

China's new Green Building Evaluation Standard (GB/T 50378-2014) regards green construction as an import rating item. It's required to effectively manage the supply chain, optimize construction procedures, and employ environmental protection and energy-saving building materials and high-and-new construction technologies.

Try to develop fully furnished buildings: try to develop fully furnished buildings in light of market demands, so as to reduce decoration waste, save time and energy for customers, guide the market consumption trend, and strictly control decoration pollution.

Enhance construction process management and reduce environmental impact: the developers shall formulate green management plans during the construction process, in order to effectively save materials, water and electricity, control the emissions of noise, raise dust, air pollutants, wastewater and wastes of the construction site, and strengthen soil protection and the protection of natural resources.

Emphasize the selection and utilization of recycling materials: select and utilize rolled steel, aluminum alloy, wood, plastering and other recycling materials in quantity during the design and procurement processes, minimize environmental load, with the proportion of recycling materials in the total weight of building materials exceeding 10%. Building materials within the 500km of the construction site shall account for more than 80% of the total weight of building materials, thus reducing transportation energy consumption during the construction process.

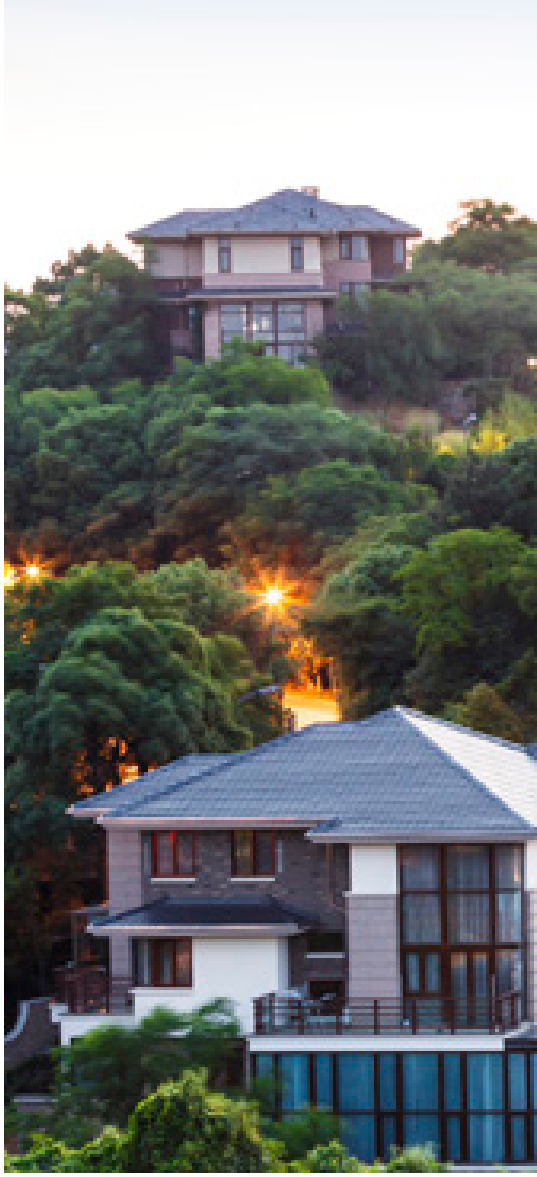
1.3Improve green operation

The cycle of architectural design and construction is about 1-3 years, while the designed service life of buildings is 70 years, which means that the operational energy consumption is far higher than that of the construction process. In this sense, advocating the green operational mode featured by energy conservation, emission reduction and resources saving is crucial to reducing the environmental impact of buildings throughout the life cycle.

Scientifically manage building equipment systems and bring the best benefits: promote system running-in and give full play to the best performance of energy-consuming equipment systems, such as energy supply, fresh air, and fuel gas through professional air balance and water balance debugging; operate and maintain ground source heat pump, solar water heating system and primary air system as well as other equipment, improve the energy efficiency ratio of the equipment, reduce energy consumption via scientific management plan, reduce operational energy cost by 20%, and improve the economic benefit and business value of developing green buildings; advance the quality of interior environment on the basis of energy efficiency improvement, and realize a balance between energy consumption and life quality.

Help the residents correctly use green buildings and improve living experience: enable the residents to know the way of correctly using green buildings and establish green lifestyle by compiling the living manual of green communities or green buildings, providing training and other means, and organize the residents to conduct garbage classification in a correct way.

2.Focus on Building Green Communities



Green communities are designed to integrate the sustainable development concept into project development, construction and management so as to ensure that citizens live in green and harmonious communities with well-equipped facilities, convenient mobility, beautiful environment and diversified styles. When it comes to the internal meaning, green communities refer to communities which have environmental-friendly public spaces, buildings and infrastructure, perfect community management mode, and witness residents' active participation in community management and practice of green ways of living. With regard to the planning of green communities, the developers shall include the core design concept of low-carbon and sustainable development into various aspects, including sustainable construction sites, transport efficiency of residential communities, efficient utilization of resources and energy, and healthy and comfortable environment. The text below lists six important principles.

2.1 Promote communities with mixed functions

Communities with mixed functions refer to communities integrating the functions of residence, commerce and retail formats which could ensure the accessibility of amenities within the areas near the residential communities. For that matter, each area shall realize a certain degree of mixed utilization, thus enabling the residents to use important amenities without long-distance trip. This is extremely important for development projects whereby senior citizens or children live in because independent long-distance trip is difficult for them, especially in the areas of wide roads occupied by automobiles.

The development of mixed functions on community land could avoid the separation of workplace and residence, pendulum traffic and long-distance transportation while offering convenient employment and services to residents, which is conductive to elevating the proportion of walking and cycling trips.

As far as the development is concerned, the ratio of jobs to residents in the commuting areas (no greater than 15 km^2) shall be controlled between 0.5 and 0.7. Six types of amenities shall be arranged within the 500m radiation radius of the building entrance of all housing units, such as school, post office, bank, retail store, clinic, activity center and restaurant, among others.

2.2 Make the best use of public transit resources

Green buildings shall be constructed based on the public transit system. The mode of Transit-oriented Development (TOD) maximizes the utilization of public transit, and cuts back on the total energy consumption and pollution of car use. All new development projects shall be built within the 500m radiation radius of bus stations or the stops of large-capacity public transit. At least 90% of the development projects across a city shall be built within the 800m radiation radius of public transit stations.

The core principle of TOD is that the land use density shall be matched with the capacity of public traffic corridors. To begin with, the floor-area ratio shall be increased within the 500-800m of the stations of subway or bus rapid transit (BRT), or within the 500m of large public transit, which shall be at least 50% higher than the average ratio, and mixed development shall be taken into account in this respect. Secondly, building entrance shall be arranged within the 500-800 walking distance from one or several bus stations. Moreover, the principle also requires improving accessible transportation facilities, properly reducing the number of parking lots and encouraging green travel.

2.3 Create small life-oriented blocks with dense road networks

A reasonable size of blocks could avoid concentrated traffic flow, inconvenient pedestrian travel, sparse public transit network and unfavorable commercial environment of the blocks. High-quality urban development shall reasonably increase the density of road networks and reduce the size of blocks. Generally speaking, the area of a block shall not exceed 2 hectares, and 70% of the blocks shall meet such standard, except for industrial areas.

Small blocks and dense road networks could create a more comfortable and convenient pedestrian environment, and make service facilities more accessible. In addition, small blocks and dense road networks could also create diversified public spaces, buildings and activities, thereby facilitating the creation of small life-oriented blocks and the enhancement of community vitality.

2.4 Provide a sound environment for walking and cycling trips

The quality of footpaths is an effective step to improve the business vitality and livable environment of communities. Cycling trip comes as the preferred green and environmental protection choice for short-distance commuting, connection with public transit, and recreational travel. A comfortable and safe non-motorized environment could promote the development of the non-motorized system.

A perfect design of the non-motorized system needs to have at least 10km-long footpaths and at least 10km-long bikeways within 1 km^2 in newly developed residential communities. In addition, it's required to set up public community spaces that cover the entire region within the 300m radius, so as to increase the accessible destinations of walking. Beyond that, the net width of sidewalks shall be no less than 1.2m, and streets with no more than 15km speed per hour shall be set up. It's unnecessary to arrange sidewalks on both sides. Sidewalks and motorways shall be separated by at least 1.2m green belts. Safety islands and pedestrian crossings shall be arranged reasonably on roads to improve the safety of the non-motorized environment.

2.5 Provide high-quality public green spaces and open spaces

Public green spaces and open spaces of communities could improve the community environment, and strengthen the styles and features of communities. During the development process, the green coverage shall account for 30% of the total area, and diversified greening methods shall be adopted in community greening. Linear green spaces with a suitable scale is more likely to attract people to stay, and enhance community vitality. User-friendly public open spaces shall

be set up within the 500m of all residential communities.

2.6 Improve water-use efficiency and rainwater usage

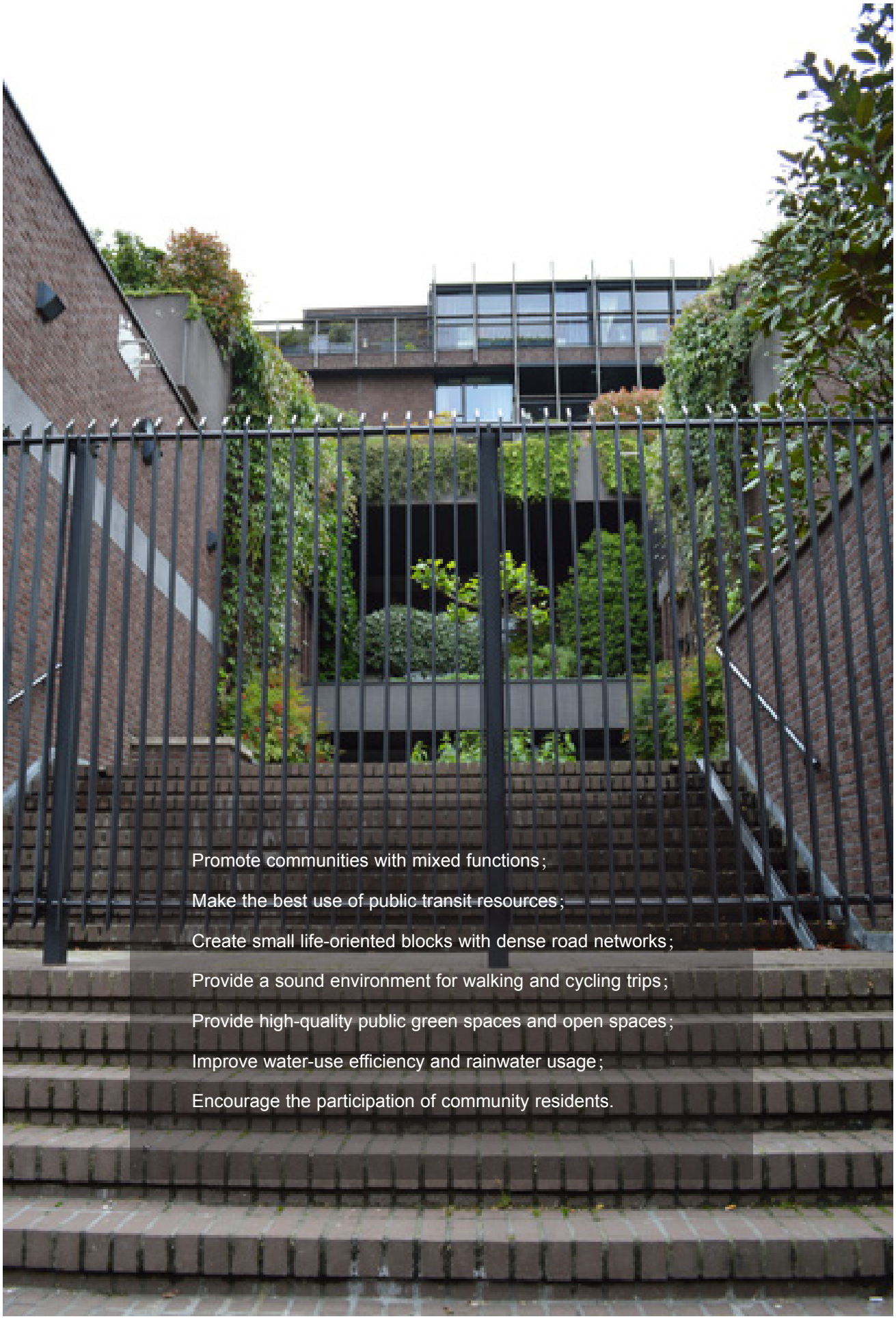
By adopting the concept of sponge cities and eco-first principle, the developers shall try to maximize the storage, permeation and purification of rainwater in communities by combining natural and artificial measures while ensuring safe draining and water-logging prevention, so as to increase the utilization of rainwater resources and the protection of the eco-environment. The developers shall implement Low Impact Development (LID) across the board, fully respect the natural features of the site, integrate the functional layout and vertical design of the sites, design and utilize low elevation greenbelts, rainwater garden, roof greening, permeable pavement, road rainwater infiltration and drainage utilization and other LID measures, link to surrounding river systems, and build natural drainage systems, so as to reduce the risk of water-logging.

By taking rainfall runoff control at the core and adopting LID technologies, the developers shall make the best use of rainfall runoff to build landscape, and create multi-functional public spaces; construct rainwater barrel, rainwater collection tank and other rainwater collection systems for use in green area irrigation, road watering, garage washing, and other purposes.

All buildings shall use water-saving equipment, and green spaces surrounding the buildings shall cultivate low water-consuming plants. All water usage shall be metered by instruments, and at least 20-30% of water supply shall come from wastewater or rainwater recycling. Residents shall use water-saving appliances in their homes, toilet flushing and other sanitary water use may use recycling water, thereby improving water-use efficiency and save water resources.

2.7 Encourage the participation of community residents

People are at the core of green communities. The uppermost goal of creating green communities is to enable the citizens to recognize, exercise and fulfill their environmental protection rights and responsibilities. Through the cooperation between development enterprises, and civil organizations and the general public, environmental management will be integrated into community management, and community-level public participation regime will be set up, thereby enhancing the environmental awareness and civilization quality of the residents. This will enable the residents to receive continuous environmental education during their daily lives to enhance environmental awareness; enable them to voluntarily select the green way of living and participate in policy proposals, thus promoting the realization of water-waving, electricity-saving, garbage classification recycling, and other low-carbon measures.



Promote communities with mixed functions;

Make the best use of public transit resources;

Create small life-oriented blocks with dense road networks;

Provide a sound environment for walking and cycling trips;

Provide high-quality public green spaces and open spaces;

Improve water-use efficiency and rainwater usage;

Encourage the participation of community residents.

3. Guide Green Development Throughout the Industry Chain

3.1 Accelerate technical research & development through multi-cooperation

This can be realized through the following means: enter into cooperation with scientific research institutions, enhance technical exchanges within the industry, speed up the research & development of generic and critical technologies for green buildings, work to resolve technologies involving the energy-saving renovation of existing buildings, utilization of renewable energy buildings, water-waving and comprehensive utilization of water resources, green building materials, waste recycling, environmental quality control and the improvement of building durability, and accelerate the popularization of efficient and energy-saving lighting products, draught fans, water pumps, water heaters, office facilities, household appliances and water-saving appliances.

3.2 Give preference to green building materials

This can be realized through the following means: adjust measures to local conditions and use local materials, select safe, durable, energy-saving, environment-friendly and construction-friendly green buildings according to local climatic features and resource availability; accelerate the development of building insulation system and materials with outstanding fireproof and heat insulation performance, and proactively develop sintered porous products, aerated concrete products, multi-functional complex integrated wall materials, integrated roof, low emissivity coated glass, bridge-cut-off thermal insulation windows and doors, sun-shading system and other building materials; and guide the utilization of high-performance concrete and high-strength steel.

3.3 Actively participate in building industrialization action

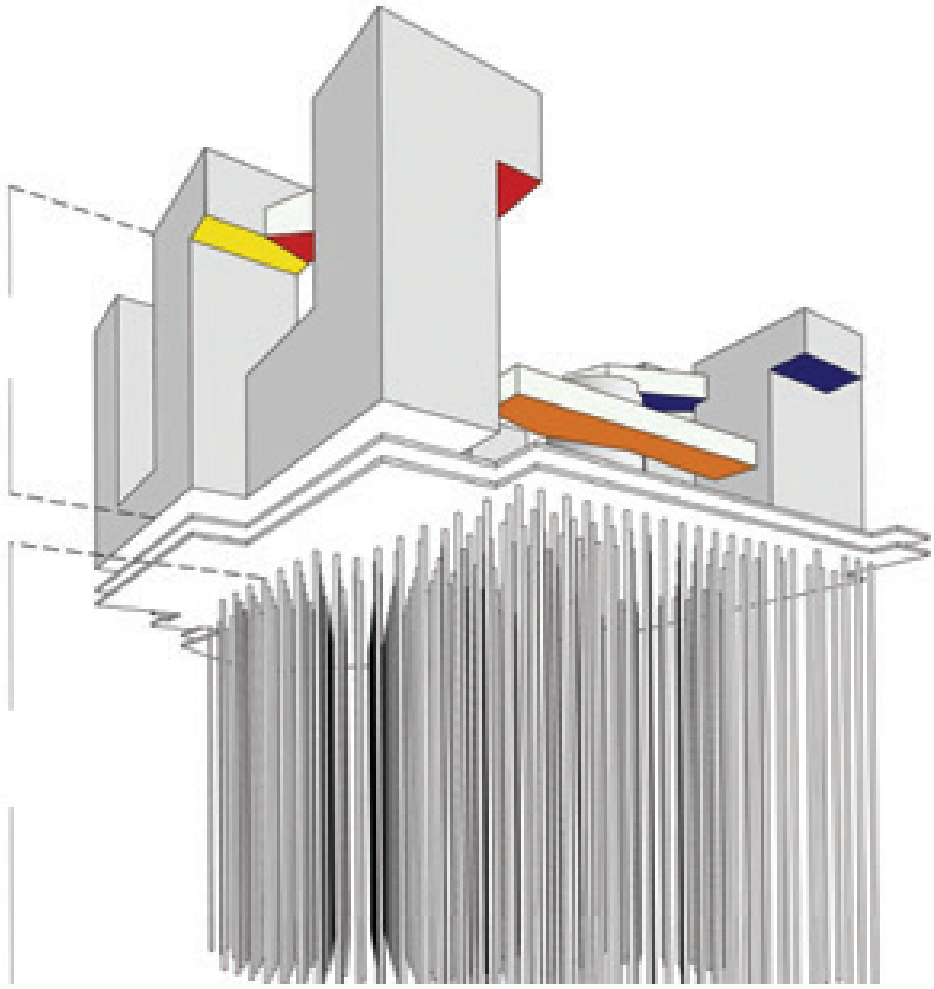
It's required to actively participate in the formulation of standards for such segments as the design, construction, and component production of building industrialization, promote the standardization of structural components, components, and parts, enrich the types of standard components, and improve universality and substitutability; popularize and use pre-fabricated concrete, steel structure and other architectural systems suitable for industrial production, expedite the development of the prefabrication and assembly technologies of construction projects, and elevate the technology integration level of building industrialization.

3.4 Increase the recycling of construction wastes

Construction wastes refer to waste soil, materials and other wastes generated during the process of constructing, rebuilding, expanding, maintaining, decorating and dismantling various types of buildings, structures and pipe networks, mainly including waste soil, waste brick, waste tile, waste concrete, scattered mortar and concrete of construction. The direct piling of construction wastes occupies land resources and invites the risks of soil pollution and water pollution.

To begin with, it's required to promote fully furnished residences, popularize the classified utilization of construction wastes, and control

decrement from the source by formulating construction plans in a scientific way; secondly, it's suggested to preferentially select renewable building materials whose quality meets demands, so as to promote the recycling of construction wastes via consumption; furthermore, it's suggested to implement the standardized collection and transportation, centralized processing and resource treatment of construction wastes.



4. Systematically Enhance Intelligent Management

4.1 Popularize BIM

Building Information Modeling (BIM) refers to establishing a building model based on relevant information data of construction projects which implements analogue simulation of the real information of buildings. BIM is defined by five major features, including visualization, harmony, simulation, optimization and figure generation. Applying BIM to plan information of the full life circle, from design, construction to operation, will promote effective information management throughout the chain, improve precision and the productivity of construction industry, directly optimize the pipe network at the design stage, reduce collision, increase the share of prefabrication, shorten the construction period, and reduce costs.

4.2 Realize Smart Communities

The safety protection system, information management system and information network system of residential communities could be put in place by comprehensively utilizing computer technology, electronic technology, communication technology, automatic control technology and other advanced information processing technology, so as to further improve the living and working environment of the owners and make their lives safer and more convenient.

Intelligentized platform is built in smart communities to monitor the operational conditions of the important system components of an individual building or building groups, reasonably establish operational standards and management plans, further improve management via smart and scientific control, and fully reduce the operational cost. Smart communities are equipped with such systems as talkback and security door monitoring system, smoke detector, household use gas leakage warning system, water, electricity and gas transmission and charge management information system, and all-fiber premise distribution system.

Part 4 Urban Green and Low-carbon Development Initiative

Urban Green and Low-carbon Development Initiative

As encouraged by the new-type urbanization strategy, a green and eco-construction boom is well underway across China. Chinese urban development enterprises have actively formulated green development strategies and embarked on constant exploration and expansion as they are committed to vigorously popularizing green buildings with all of their strengths, building green communities, guiding green development throughout the industry chain, and systematically enhancing smart management, thereby creating a more beautiful future. The planning, construction and practice of green development would be impossible without the recognition and participation of all stakeholders. The communications and cooperation between enterprises, and governments, research institutions, the public and even international organizations, and the inheritance and promotion of Chinese traditional culture, are highly important for China's green development. Therefore, the urban development enterprises in China promoted the urban green and low-carbon development initiative.

- Government deepens reform:
Systematic policy guarantee system
- Enterprises' low carbon practice:
Active development of green market
- Active participation of the public:
Take the initiative in living a green life .

1. Deepening Reform by the Government: Systematic Policy Guarantee System

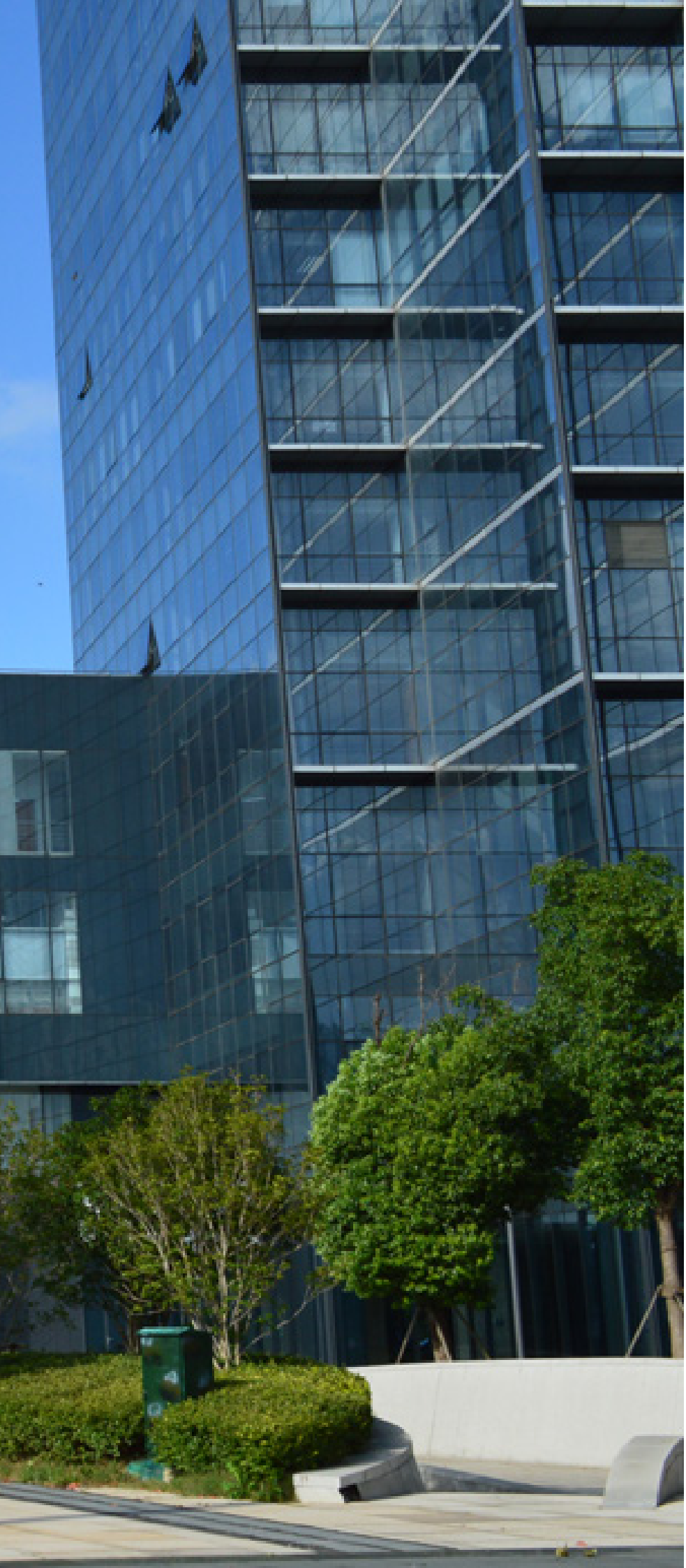
1.1 Improve technical standards and speed up the establishment of the system for managing and safeguarding urban green development

It's required to establish a broad communication mechanism for governments and enterprises through conferences, workshops, coordinated formulation of standards, and other means; improve the design standards and technical codes related to green development and construction; promote the upgrading of materials and technologies throughout the industry chain via government-enterprise cooperation, including green building materials, green products and green construction; and promote the industrialized development of residences and modularization of fabricated buildings and components.

It's necessary to put in place policy guarantee in terms of industry, environmental protection, transportation, residential housing, public finance and tax, resource and energy utilization, strictly implement standards and codes, and ensure the construction quality and sustainability of green development through powerful supervisory regimes. On the one hand, it's required to improve the third party system to realize social supervision; set up a host of certification systems for green buildings, green household appliances, green building materials, and energy-saving construction equipment, and provide all-round quality supervision for each stage of green development, including design, construction, operational and management; on the other hand, it's required to establish green building vocational qualification certificate and other systems, set up the market access system for green development, improve and regulate the technical competence and professional behavior of the practitioners, thereby safeguarding the quality of the technical market of green development.

1.2 Enhance consumption guidance and improve incentive policies for the purpose of market cultivation

The release of effective incentive and compulsory policies by the government represents an important way to promote urban green development. It's required to implement the financial incentive policies on the construction of high star-level green buildings, and green and eco-cities, further identify and improve the system for the implementation and guarantee of various types of incentive measures, such as financial subsidy, award for area of structure, tax reduction or exemption, rapid examination



and approval, and preferential loan; establish preferential policies and measures concerning increased loan credit and subsidy for purchasing green housing products, so as to directly promote the development of green buildings by encouraging consumption; beef up financial support for low-carbon technologies and projects, promote enterprises and governments to build a "green" consensus, formulate a more practical and organic policy regime to support green development actions, and fully mobilize the regulating role of the market.

1.3 Strengthen government-enterprise cooperation and make innovations in the investment and financing system for urban green development

It's important to actively expand the financing channel of urban green development, comprehensively utilize government bond, policy-based finance, special construction fund and other means of investment, encourage to raise funds for urban low-carbon projects with larger financing demands at the early stage, including public transportation infrastructure and green and energy-saving buildings, by attracting the participation of venture capital fund organizations and issuing low-carbon bonds; strengthen cooperation between governments and social capital in key fields, establish and improve the measures for non-public enterprises to enter into franchising sectors, guide and mobilize social capital to participate in low-carbon urban construction through public-private-partnership (PPP), build-operate-transfer (BOT) and other mechanisms, improve the benefit sharing and safeguarding system, and tackle such issues as the high construction cost, long payback time and high investment risks of low-carbon projects.

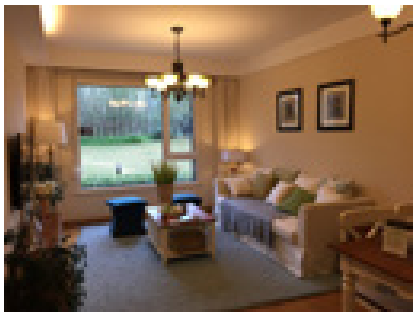
1.4 Give play to the functions of the market and promote cities to develop low-carbon economic innovation system

It's proposed to give play to the functions of the market, promote urban development enterprises and governments to jointly study on

and practice innovative economic and market means, develop low-carbon economy, and drive urban economic development and employment.

Firstly, it's important to introduce the market system for the trading of carbon emission or building energy consumption quota into the development industry on the basis of pilot and expansion, accelerate the construction of the trading platform for public building energy conservation or building carbon trading segment, and provide the innovative concept of economic structure for ecological civilization construction and new-type urbanization development.

Secondly, it's necessary to fully utilize contractual energy management and other market means to promote building energy efficiency: actively encourage to conduct contractual energy management projects in urban buildings and other major energy-saving sectors, improve relevant management rules, enhance



studies on the calculation and methodology of energy-saving benefits, improve and enhance the system for guaranteeing energy-saving benefits, clear away the obstacles to the popularization and application of energy-saving services, and increase the initiative in market participation.

2. Low-Carbon Practice of Enterprises: Vigorous Green Market Development

2.1 Carbon emission throughout the urban development industry helps China realize the carbon emission peak target

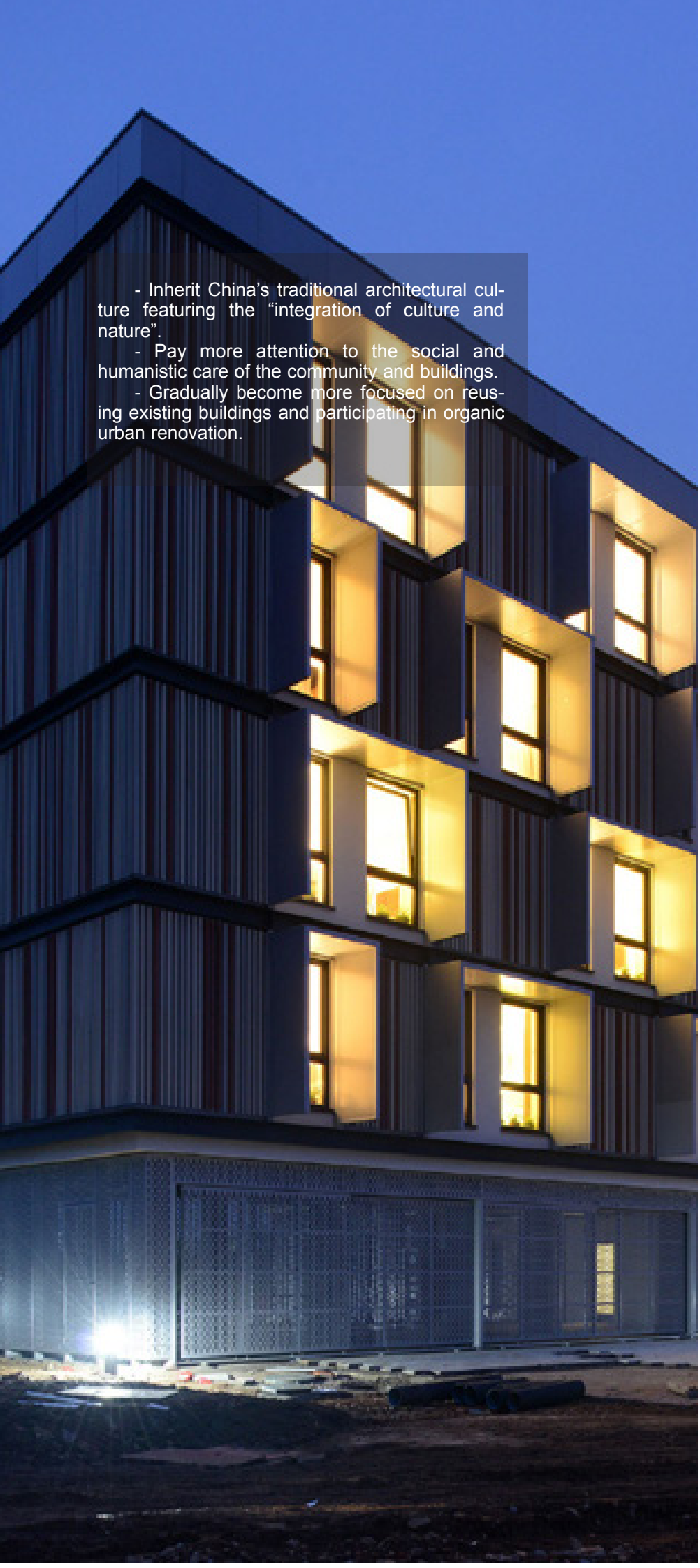
1) Set the target for carbon emission peak of the real estate industry and the roadmap

Systematic policy guarantee system, enterprises' active carbon reduction strategies, extensive public participation, and international cooperation, among other factors, will drive Chinese urban development companies to move forward in their progress of green and low carbon development. These companies will conduct cooperation with the government, research institutions, the public and international institutes to improve the green development strategy, implement the core principle of green development, promote market-oriented green development, deliver "extremely comfortable and low energy consuming" work and living space to users, and push forward the green construction trend around the globe.

It's suggested to analyze the overall carbon emission source and mix of the real estate industry, develop the roadmap, and realize the goals that no less than 50% of new buildings are green buildings within the new-type urbanization planning in the short term (2020), that no less than 13% of energy utilized in cities is renewable energy, that there is a significant reduction in the overall carbon intensity of the real estate industry in the medium term (2025), and that industrial carbon emission peak is reached before 2030. These goals can be realized by internal industrial restructuring, optimization of energy consumption structure, advancement and innovation of construction technology, and the establishment of the system of forcing the transition of the property management mode.

2) Explore into the transition of urban development to "Climate Positive Development" mode throughout the full life circle

It's suggested to conduct low-carbon real estate development pilot programs, explore into



the real estate "Climate Positive Development" mode throughout the process of planning, construction, operation and management, comprehensively advance the development of green eco-environment based on the three supporting systems -- renewable energy supply and utilization, low-carbon green buildings, and low-carbon municipal supporting facilities, explore into the mode of low-carbon construction and property management, realize the "Climate Positive Development" mode, i.e., not only reduce the emission from the development projects, but also eliminate the emission of surrounding communities via the external effects, thereby realizing the goal of net or negative emission on the whole.

3) Improve the data base for the statistics and measurement of carbon emission data

It's important to improve the statistics of carbon emission data, and set up the standards for the measurement of carbon emission of the urban development industry and the low-carbon development goals of enterprises. It's suggested to create the carbon emission database of the real estate industry, explore into the establishment of carbon emission evaluation system for real estate development projects that build new cities and reform existing urban areas, so as to promote people within and without the industry to recognize the scientific basis for controlling carbon emission, promote the compilation of carbon emission evaluation standards and guidance in light of the features of the real estate industry, and enable enterprises to have an objective verification basis when making decisions as they transit to the low-carbon development mode. Urban development enterprises may be encouraged to formulate corporate climate change plans, corporate low-carbon development goals, and corporate systems for carbon information disclosure.

2.2 Align with research institutes and cultivate technical talents

It's necessary to enhance technical innovation and the cultivation of professionals, and promote the continuous and healthy development of the green development industry. Through cooperation between enterprises and institutions of high learning and based on the mode of "theory-practice combination", it will be possible to expand the international horizon of students of architecture-related majors, elevate the concept of green and sustainable development, and cultivate professional talents in architectural design, technical research & development, system energy conservation, construction management and property management that conform to the green development direction; encourage enterprises to enter into partnerships with research institutions, and put forward research & development demands from the perspective of industrial development orientation, while promoting the industrialization of outstanding new technologies, forming effective interaction and jointly elevating the technical level of green development.

2.3 Enhance cultural inheritance and social care

1) Carry forward China's traditional architectural culture featured by "unity of heaven and man"

Architecture is the crystal of human material civilization and spiritual civilization, and is the representative of a cultural type. China is a country with time-honored history, vast territory and integration of multiple national cultures, and has developed traditional architectural forms which have different styles and internal meanings. Up till now, the concepts in China's traditional architectural culture, including "unity of heaven and man" and "people-orientation", are still consistent with the direction of public demands for environmental quality and with the green and low-carbon concepts, so they enjoy an important directive role. During the process of future green development, it's important to fully tap into the traditional techniques in traditional buildings, such as lighting and heat preservation, integrate traditional techniques, materials and cultural elements with the means of contemporary buildings in a comprehensive way, and carry forward China's traditional architectural culture towards not only the Chinese people, but also the entire international community.

2) Pay attention to the social humanistic care of communities and buildings

China's traditional culture has always emphasized people-orientation. Therefore, during the process of community or construction planning and design, it's important to value social equity, develop mixed communities, and enable different income groups to have an equal access to public service facilities. As China's aging society comes, it's necessary to provide more care for the senior citizens and build "seniors -friendly communities".

3) Pay attention to the transformation of existing buildings and organic upgrading of cities

As China's urbanization development advances, the rapidly growing trend of new constructions will slow down. China's National New-type Urbanization Plan indicates to strictly control the size of newly increased construction land in mega cities, while properly increasing the supply of construction land in satellite cities, small and medium-sized cities and counties. In this case, the vitalization of stock land, transformation of existing buildings and upgrading of old towns will attract more and more attention during the future development and construction. Green development shall pay more attention to stock development, keep a watchful eye on the transformation and reutilization of existing buildings, and actively participate in the organic upgrading of old urban areas.

3. Active Participation of the Public: Voluntary Green Lifestyle

The general public is the consumer and user of buildings, while public participation is a specific reflection of their supports for green development and construction. Therefore, changing the public concept, enhancing green humanistic construction, constantly improving the public acceptance to fully furnished residences and green eco-technologies, and building beautiful dwelling spaces are critical to the progress of China's green development market.

3.1 Practice green lifestyle

It's necessary to advocate the frugal consumption view; promote all citizens to transit to a frugal, green, low-carbon, civilized and healthy way in clothing, food, housing, mobility and trip, among other aspects of daily lives; improve new energy vehicle charging points and other supporting facilities, and guide the consumers to buy new energy vehicles, energy-efficient household appliances, water-saving appliances, and other energy-saving, environmental protection and low-carbon products; vigorously popularize green and low-carbon trip, and advocate the green modes of living and relaxation.

3.2 NGOs and volunteers actively play their guiding role

Non-governmental organizations (NGOs), experts and social organizations are suggested to hold salons, competitions, studies and other diversified discussions or participatory activities on

a regular basis, with a view to publicize green concept and energy-saving and environmental protection knowledge, and promote the public to build a consensus. It's also necessary to give full play to the role of news media, project a rational and positive direction of public opinions, enhance the publicity of national conditions about resources and the environment, popularize laws, regulations and knowledge about green and environmental protection, and enhance the public's senses of conservation, environmental protection and ecological development.

3.3 Utilize information-based means to improve the public participation system

It's required to disclose various environmental information of communities or buildings in a timely and correct way, safeguard the public's right to know and their environmental rights and interests. The public may exchange their community life experience, report issues in terms of ecological protection and environmental development, and voice their inputs for improving the living environment via the Internet, mobile phone applications and other channels. In an environment with more symmetrical information, the public will participate in community activities in a more active and enthusiastic manner, and jointly create a beautiful living environment with green lifestyle.

Together, the systematic policy guarantee system, active corporate carbon emission reduction strategies, broad public participation, and international cooperation will provide more favorable driving

The general public is the consumer and user of buildings, while public participation is a specific reflection of their supports for green development and construction, which shall be enhanced to jointly build beautiful dwelling spaces.

forces for Chinese urban development enterprises in their green and low-carbon development practices. Going forward, Chinese urban development enterprises will join hands with governments, academic institutions, the public and international organizations, improve green development strategies, fulfill in the core principle for green development, and press ahead with green development with market-based means. In doing so, they will be well-placed to provide the users with “highly comfortable and low energy-consuming” working and living spaces and jointly move forward the international green construction trend.

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