TrueSmart and Green City?
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New sustainable urban design strategies for the Beijing region's most extensive green, compact city

- Case study of Bohai innovation city

Juntaek Kim 1, Uoo Sang Yoo 2*

1 Skidmore, Owings and Merrill / 224 S. Michigan Ave, Suite 1000, Chicago IL, 60616, USA
2 Chonnam National University / Gwangju 500-757, South Korea, Corresponding Author
E-Mails: juntaek.kim@som.com; usyoo@chonnam.ac.kr
* Tel.: +82-2094-1644; Fax: +82-530-1639

INTRODUCTION

The idea of the smart city emerged during the last decade as a platform of ideas about how new technologies might improve the function of cities, enhance their efficiency, and improve their competitiveness. It might also provide new ways in which problems of environmental degradation, imbalanced access to public infrastructure, and spatial segregation based on economic separation could be addressed.

The essence of the ideas revolves around the need to coordinate and integrate technologies into their program mix that have hitherto been developed separately from one another, but which have clear synergies.

They need to be interconnected so that many new opportunities can be realized that could improve the quality of life of residents. This study is based on the new city design project in south Beijing, which was planned carefully using comprehensive strategies and is being implemented in a way that is economically rational, but environmentally resilient.

URBANIZATION IN BEIJING

Rapid urbanization has led to formidable urban issues

URBAN SPRAWL

SINGLE-USE DISTRICTS

CAR-ORIENTED PLANNING

ENERGY CONSUMPTION

EXPLOSIVE URBAN POPULATION

AIR POLLUTION

WATER SHORTAGES

LACK OF IDENTITY

PROBLEMS AND SOLUTIONS OF A NEW CITY DESIGN

Urban growth in China

The Beijing new town developments took on an important role in preventing excessive population density, and were fairly successful in terms of industrial distribution. However, they failed to redistribute the population, so job and housing discord got worse.

This new plan, based on urban diversity, calls for a new urban planning strategy, as well as a wide functional and spatial network connecting neighboring regions to improve functional congestion in the central region. For the success of this new plan, an integrated urban design is needed, in which the various resources of the urban area can be allocated in a comprehensive fashion.

Cities as problems	Cities as solutions
• Environmental degradation • Loss of agricultural land • Pressure on natural resources • Pressure on housing and employment • Consumptive patterns • Urban sprawl • Social alienation • Damaging urban-rural linkage	• Driving forces in economic development • Efficient use of energy and infrastructure • Easier delivery of health and education services • Centers for culture and tradition • Efficient use of natural resources • Creative social capital • Potential centers of innovation and experimentation

PROBLEMS AND SOLUTIONS OF A NEW CITY DESIGN

Strategies for smarter growth

Issues of Urban Design in China	The Strategies for Smart City Design
• Quantifiable area based design control - Site coverage, population, FAR, green ratio, height limit • Maximum development under allowable land use permit • Disconnected single land use character • Limited research and planning within a project boundary • Rely on centralized urban infrastructure and government service • Public service followed by demand • Design from a Tabula rasa	• Performance based design • Compact and walkable development • Higher density with convenient transportation that is aligned with a mix of land uses • Transit as the first choice and the first investment • Innovative design adapted from regional context and an authentic sense of place • Networked public spaces of all kinds and scales • Information based public service • Visible display of “newness” and making technological innovations feel approachable • Holistic commitment to sustaining the quality and integrity of the larger ecosystem • Aesthetic consideration and locality

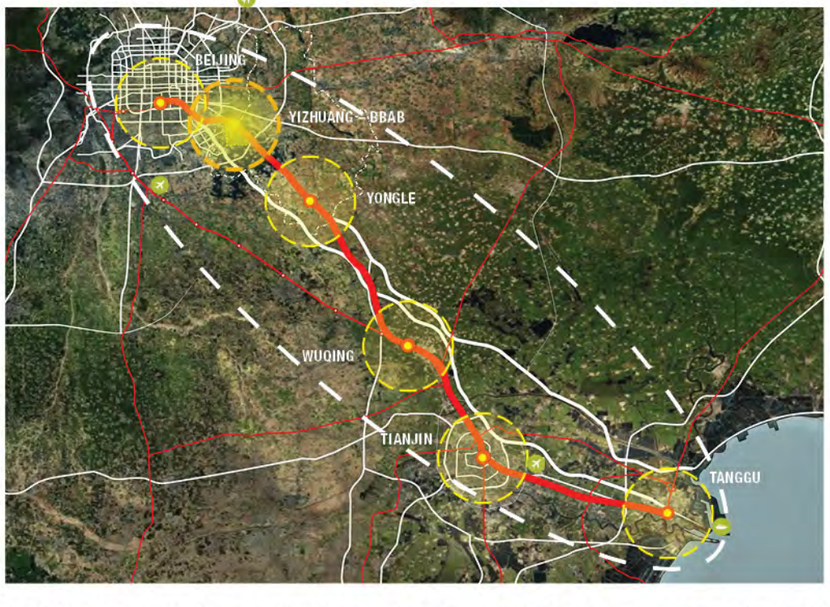
BOHAI INNOVATION CITY AS A SMART CITY

A new metropolitan corridor forming along the Beijing-Tianjin HSR line

The master plan leverages the recent high-speed rail line constructed between Beijing and Tianjin in 2008. Reducing the previous 3-hour drive to a 45-minute train ride, the rail line becomes a catalyst for a regional approach to urban development. Collectively, a metropolitan corridor emerges in this dynamic Bohai region--home to more than 200 million people.

In the Bohai Innovation City, the urban design strategies for a smart city are applied to its urban spatial design to maximize the strategic advantage of the Bohai region and to provide better quality of life and sustainable urban development. The network idea is critical for organizing other smart design strategies that were developed for this project:

- Comprehensive transit network for compact walkable district and connected neighborhoods
- Integrated environmental network with interconnected Green Infrastructure, and
- High-performance urban design for resource management,



BEIJING-TIANJIN CORRIDOR: HIGH SPEED RAIL AS A GROWTH ENGINEREGIONAL FUNCTION AND SPATIAL NETWORKS

BOHAI INNOVATION CITY AS A SMART CITY

The Strategies for Smart City Design

01 SMARTER GROWTH
Shaping the city, respecting the land

02 COMPREHENSIVE TRANSIT CONNECTIVITY
Advanced, multi-modal transportation network

03 COMPACT WALKABLE CORE
Creative and innovative places built around a high-density, mixed-use heart

04 CONNECTED NEIGHBORHOODS
Mixed-use neighborhoods linked by public transit and walkable streets

05 INTEGRATED NATURAL SYSTEMS
In balance with nature and ecology

06 HIGH PERFORMANCE URBAN DESIGN
Fostering environmental stewardship

01 SMARTER GROWTH

Shaping the city, respecting the land

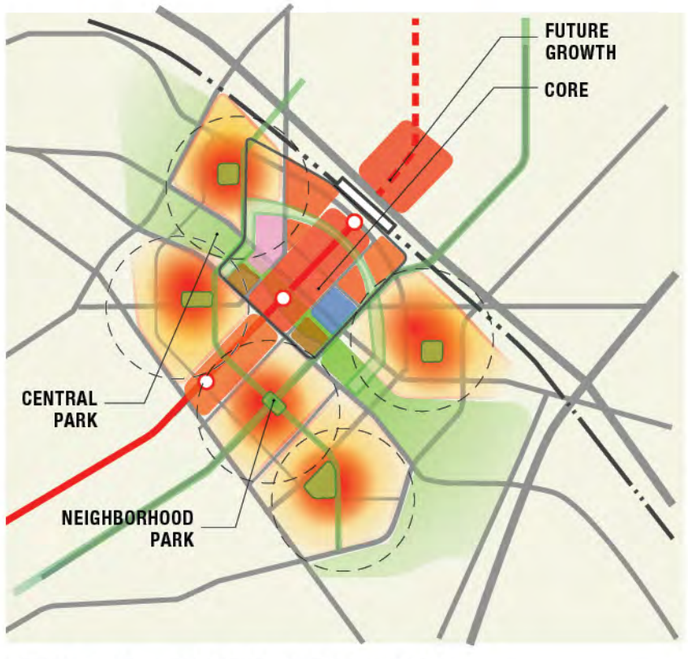
UNCONTROLLED URBAN SPRAWL

REFOCUSED, COMPACT AND CONNECTED SETTLEMENT

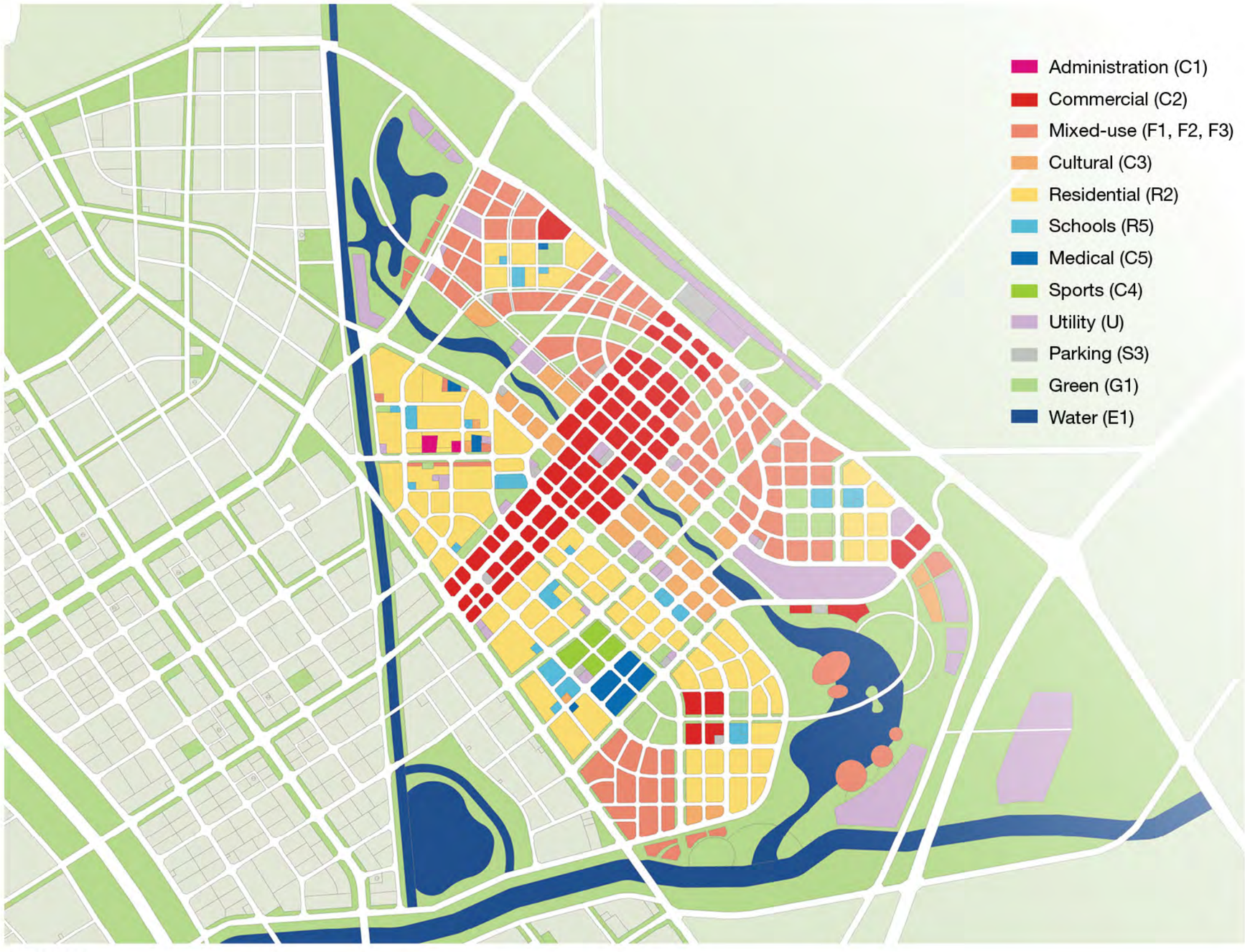
01 SMARTER GROWTH

Compact, mixed-use urban development allows for substantial open space preservation

STREET NETWORK



ONE CORE + FIVE NEIGHBORHOODS



LAND USE

02 COMPREHENSIVE TRANSIT CONNECTIVITY

Multiple transit modes operating at local, metropolitan and regional scales

Projected commute modal splits

10% HIGH SPEED RAIL

25% METRO

5% BRT

5% STREET CAR

20% CAR

10% BIKE

15% WALK

(TBD) FUTURE SHARED MODES

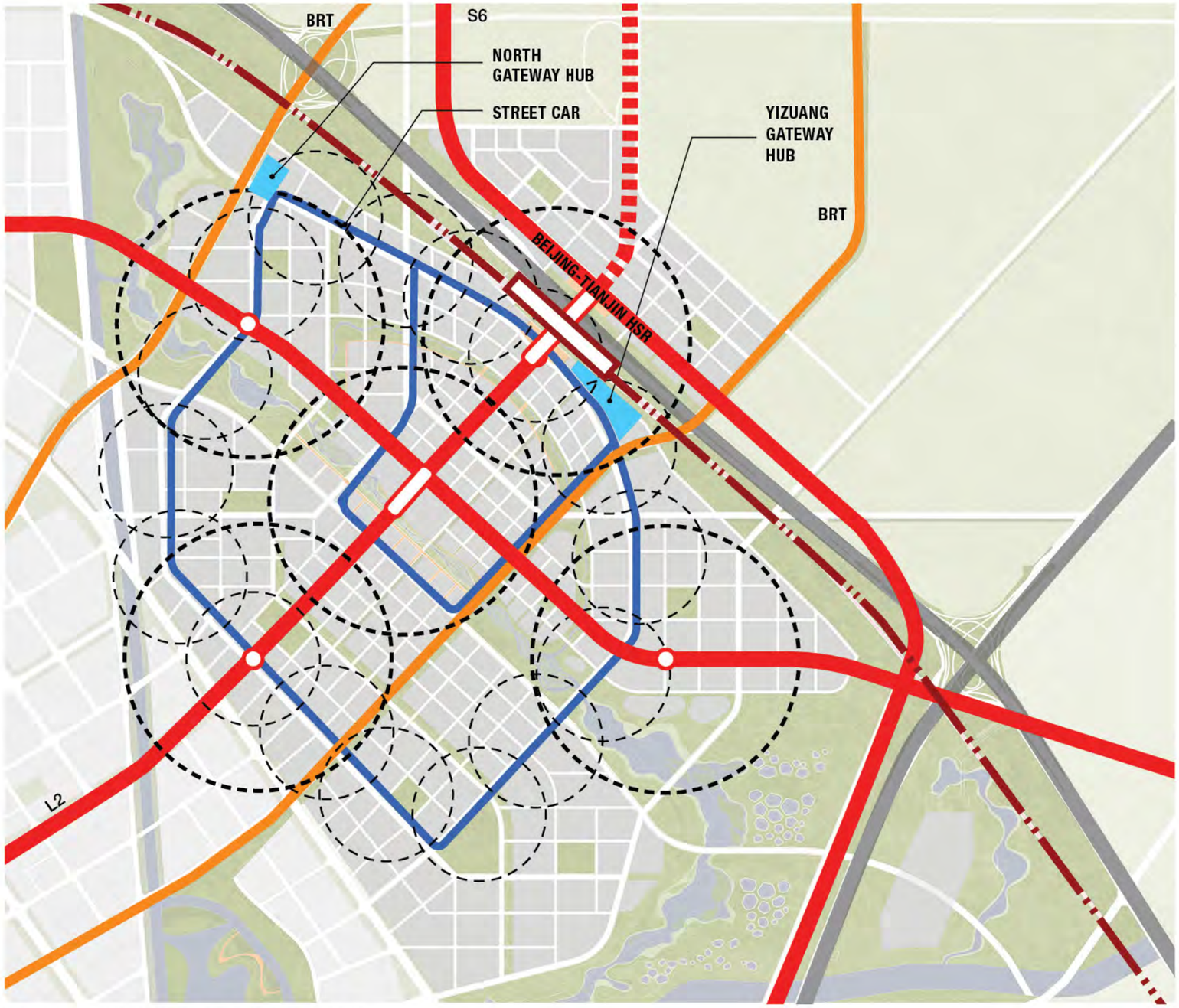
02 COMPREHENSIVE TRANSIT CONNECTIVITY

Advanced, multi-modal transportation network

The master plan leverages the high-speed rail station, building a multi-modal transit network off of the existing gateway. Three subway lines, a local streetcar loop, regional BRT will converge to create the most convenient transit oriented district in the region.

All modes of transit serve to optimize transit coverage through the district. Internal transit systems provide efficient connections to external modes of transit for fast connections to the Beijing-Tianjin region. All streets are designed to accommodate bikes and pedestrians, while land uses are distributed such that walking and biking become a primary means of circulation.

In the future, Bohai Innovation City will become a regional hub, offering direct connections to both of Beijing's airports, Beijing South Rail Station, as well as the major rail stations of Tianjin and Binhai.



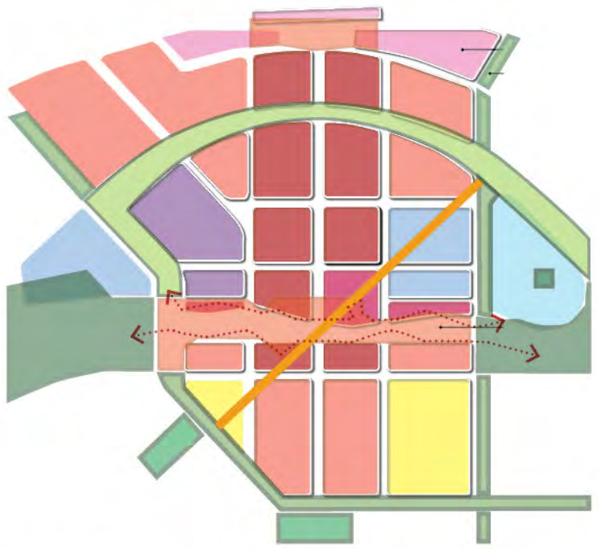
COMPREHENSIVE TRANSIT NETWORK

03 COMPACT, WALKABLE CORE

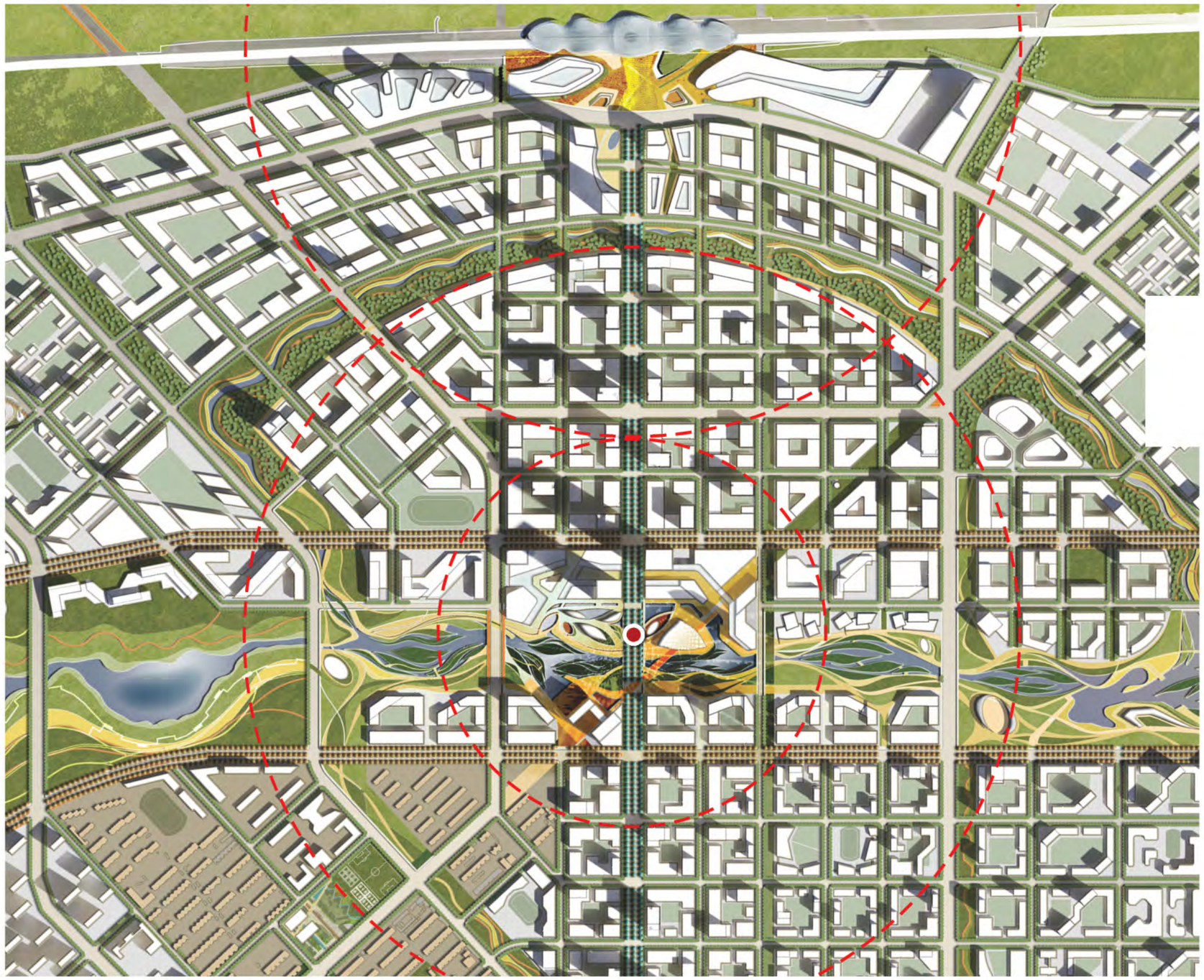
Creative and innovative places built around a high-density, mixed-use heart

The core is designed around the existing Ciqu and Yizhuang metro stations, ensuring that 90% of the core area is within a 10-minute walk of regional transit. Mixed-use and higher density, the core becomes a model of new Chinese suburban development.

The core area contains a mix of uses to stimulate urban life and innovation. Commercial uses are complemented by R&D, retail/entertainment and residential uses. A special university campus and medical campus occupy prime space at the periphery of the core.



LAND USE IN THE URBAN CORE



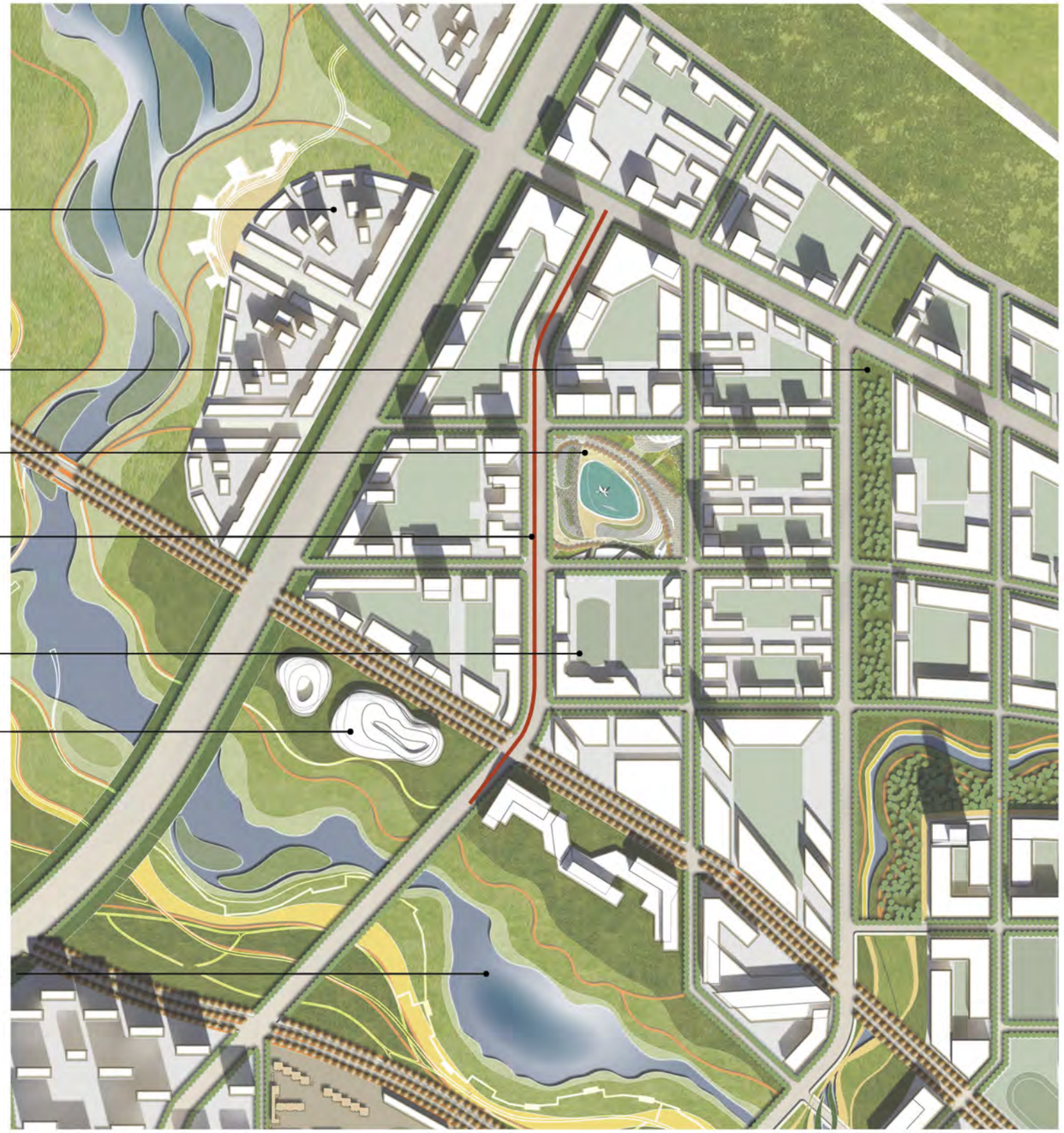
04 CONNECTED NEIGHBORHOODS

Mixed-use neighborhoods linked by public transit and walkable streets

RETAIL STREETS CONNECT NEIGHBORHOOD CENTERS

DISTRICT BOULEVARDS DEFINE NEIGHBORHOODS

DIVERSE NEIGHBORHOOD CHARACTER



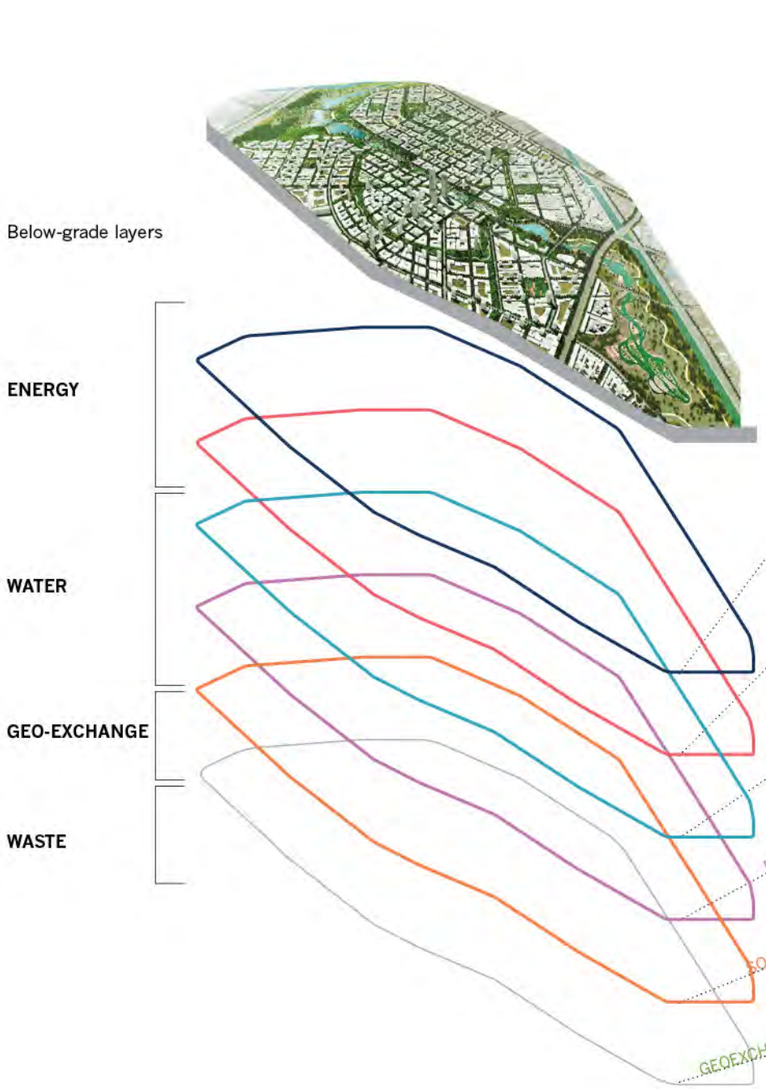
MIXED-USE URBAN NEIGHBORHOOD

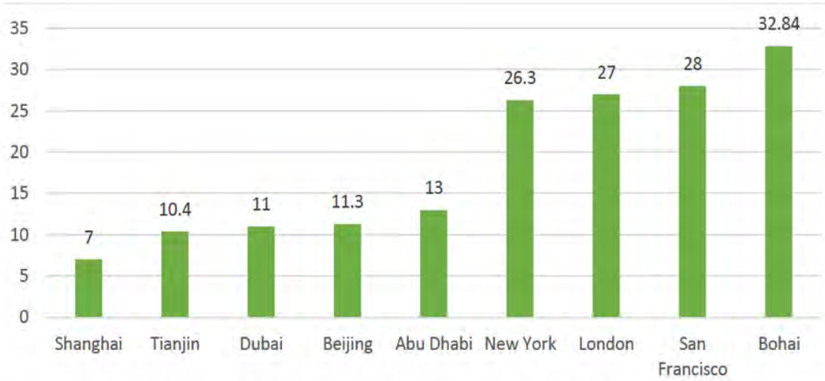
05 INTEGRATED ENVIRONMENTAL NETWORK

Interconnected Green Infrastructure

Networks are the infrastructure by which this plan is intended to provide collective reduction of costs while increasing density with great efficiency. However, increasing urbanization in certain areas causes tension surrounding the compromise between reliability and resilience.

An enhanced district utility network allows a closer look at each utility provided, to discover expanded uses for each resource, to optimize redundancies, and to minimize energy use. Services that are traditionally produced at the building level can be better provided at the district level by achieving economies of scale. An enhanced utility network with interconnected district nodes provides cooling, heating and power to the entire development. It also supplements the city utility grid with on-site cogeneration systems involving renewable energy, rainwater management, and vegetation.



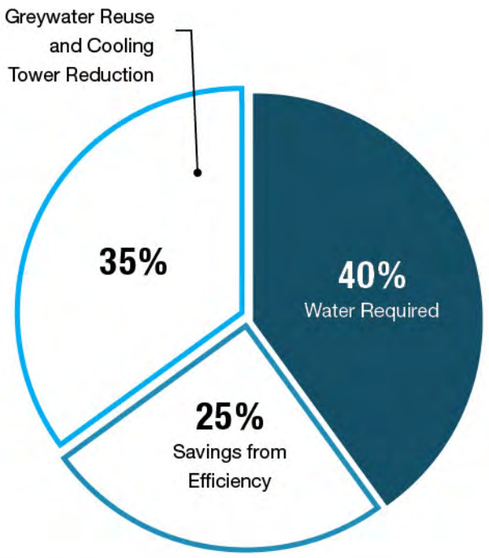


PUBLIC URBAN GREEN LAND AREA PER CAPITA

06 HIGH PERFORMANCE DESIGN FOR SMART RESOURCE MANAGEMENT

Green infrastructure intervened with water management system

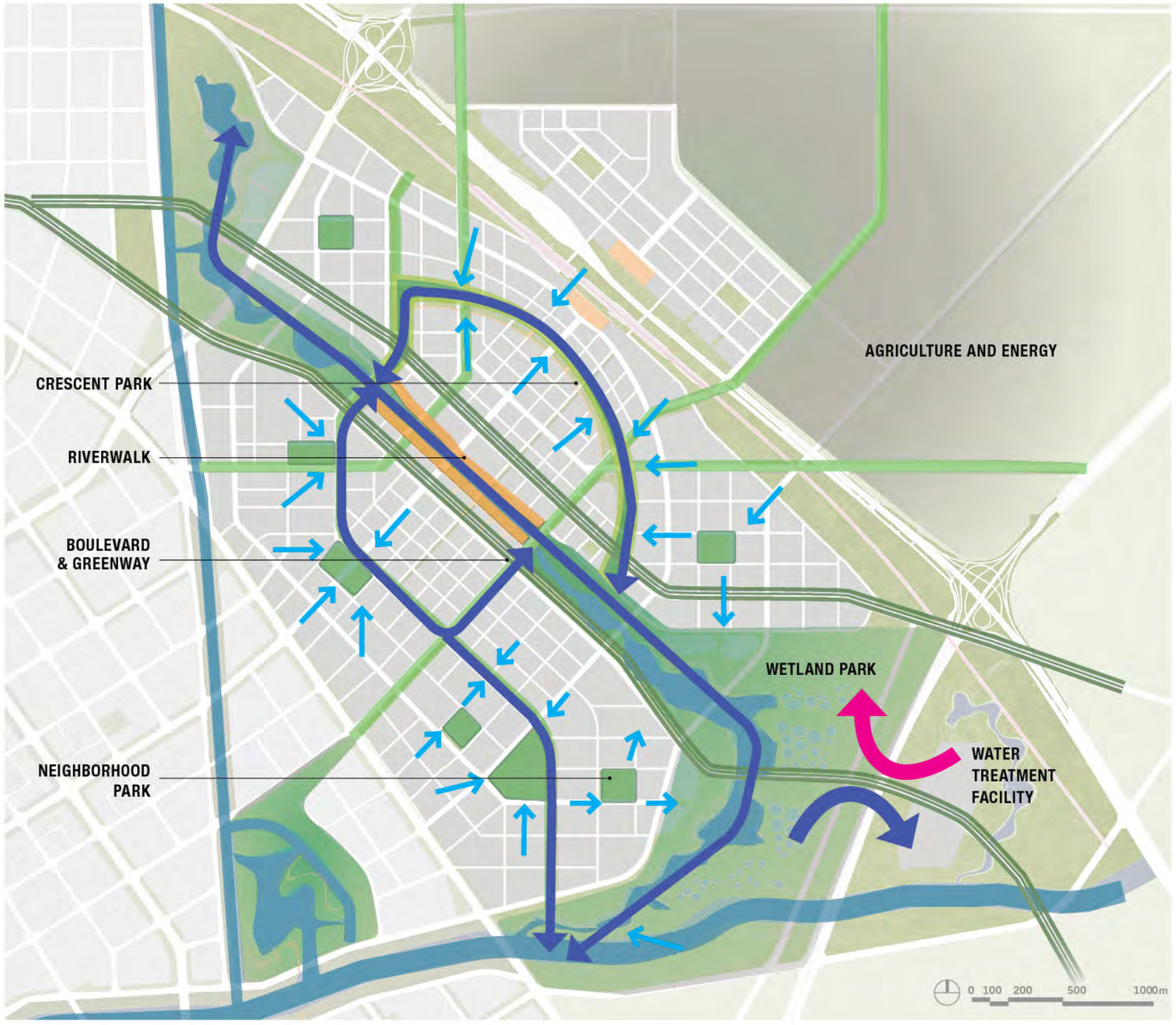
An expanded network of green spaces, including the iconic Crescent Park running through the core, allows additional opportunities to collect and clean stormwater run-off through natural systems. Helping to conserve precious water resources and the energy typically needed for water treatment, this comprehensive water-based landscape will become a model for sustainable urban landscape design.



30% Energy Use Reduction by Efficient Measures

10% On-site Renewable Energy Generation

60%
WATER CONSERVATION



SITEWIDE STORMWATER RETENTION AND BIOFILTRATION

06 HIGH PERFORMANCE DESIGN FOR SMART RESOURCE MANAGEMENT

Enhanced Green Network System

• Plane Type: An expanded network of green spaces, including the iconic Crescent Park running through the core, allows additional opportunities to collect and clean storm water run-off through natural systems. Helping to conserve precious water resources and the energy typically needed for water treatment, this comprehensive water-based landscape will become a model for sustainable

urban landscape plan. Wetlands are proposed to be located at both the South and North ends of the city. They will occupy 23% of the total area, and provide 55% of the open space. The largest man-made wet area among new cities planned around Beijing, this wetland will be able to maintain biological diversity and perform as an urban micro climate control. The wetland also functions as a detention facility to protect against flooding disasters caused by the Summer Monsoon.

WETLAND PARK

NEIGHBORHOOD PARK

AGRICULTURE AND ENERGY

• Linear Type: As connectors among the major plane type open spaces, this green infrastructure includes eco-corridors, wind-corridors, view-corridors, water streams, promenades, and green pedestrian paths. These open spaces provide essential green connections between various open spaces to support natural systems and essential wind flow patterns. The various kinds of open spaces are to create an integrated network to amplify the synergy. Here again, the connection types of the green infrastructure proposed by network theory can be divided into two groups. One is the branching network type commonly observed in the natural landscape; the other is the circuit network type which includes most network types found in urban settings.

RIVERWALK

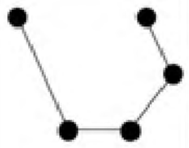
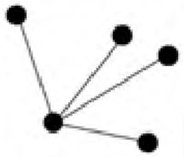
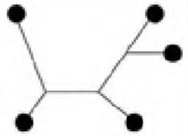
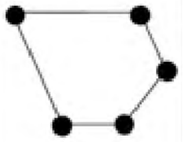
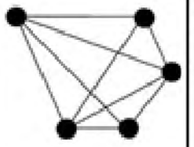
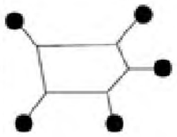
CRESCENT PARK

BOULEVARD & GREENWAY

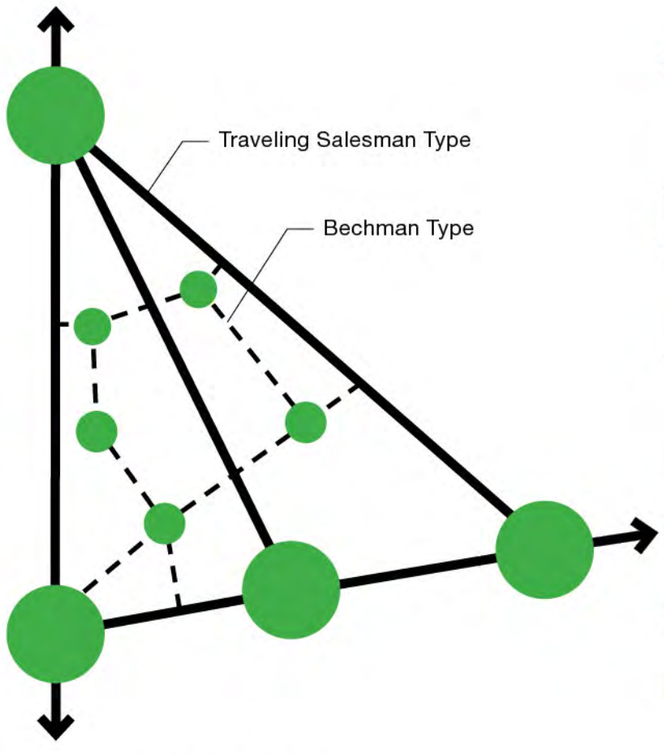
VARIOUS PUBLIC OPEN SPACES AND GREEN INFRASTRUCTURE NETWORK

06 HIGH PERFORMANCE DESIGN FOR SMART RESOURCE MANAGEMENT

Green Network Typology

Branching Networks			Circuit Networks		
Paul Revere	Hierarchical	Least Cost to Builder	Traveling Salesman	Least Cost to User	Bechman Typology
					

GREENWAY NETWORK TYPOLOGY



PLANNED GREENWAY SYSTEM

CONCLUSION

Smart growth and sustaining the city

Smart growth is a movement that implies we can achieve greater efficiencies by coordinating the forces that lead to laissez faire growth, using guidelines to avoid market-dictated sprawl development. The Chinese urban development pattern is evolving to accommodate socio-economical sustainability while pursuing environmentally livable places. This will be done using innovative technologies and management systems. This study reviewed the key urban design issues in China and explored new urban design strategies that stress the quality of growth.

Once early-phase districts and buildings are completed in the Bohai Innovation City, numerous key indicators will be established, allowing for the adjustment and optimization of the infrastructure and systems as required from the optimal distribution of energy, to enhanced performance, and integration of the transit and mobility networks. Over time, extensive network systems like transit, open space, infrastructure, and an upgraded management system will help to maintain a sustainable and highly livable place.

An integrated open space network and intelligent water management system will further contribute energy savings, and optimize the re-use and re-cycling of water by balancing the supplies and demands through centralized point-of-use treatment technologies. The smart city will also effectively monitor the hydrology and ecological performance of its watershed to efficiently replenish aquifers and restore a sustainable balance of water resources throughout the region using the proposed wetland system.

The Bohai Project has the potential to provide a broader view of the future “smart city” and to define what that may imply. In this paper, we have explored diverse drivers shaping the role of smart cities and assessed the implications that these may have on new city designs and the delivery of cutting-edge green infrastructure.