

Changjiang New Town Wuhan, China

May, 2018



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Strategies to Create the City of the Future

May, 2018

About the Urban Land Institute

THE URBAN LAND INSTITUTE is a global, member-driven organisation comprising more than 40,000 real estate and urban development professionals dedicated to advancing the Institute's mission of providing leadership in the responsible use of land and creating and sustaining thriving communities worldwide.

ULI's interdisciplinary membership represents all aspects of the industry, including developers, property owners, investors, architects, urban planners, public officials, real estate brokers, appraisers, attorneys, engineers, financiers, and academics. Established in 1936, the Institute has a presence in the Americas, Europe, and Asia Pacific regions, with members in 80 countries.

The extraordinary impact that ULI makes on land use decision making is based on its members sharing expertise on

a variety of factors affecting the built environment, including urbanisation, demographic and population changes, new economic drivers, technology advancements, and environmental concerns.

Peer-to-peer learning is achieved through the knowledge shared by members at thousands of convenings each year that reinforce ULI's position as a global authority on land use and real estate. In 2017 alone, more than 1,900 events were held in 290 cities around the world.

Drawing on the work of its members, the Institute recognises and shares best practices in urban design and development for the benefit of communities around the globe.

More information is available at uli.org. Follow ULI on Twitter, Facebook, LinkedIn, and Instagram.

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About ULI Advisory Services

THE GOAL OF THE ULI ADVISORY SERVICES programme is to bring the finest expertise in the real estate field to bear on complex land use planning and development projects, programmes, and policies. Since 1947, this programme has assembled well over 600 ULI-member teams to help local communities find creative, practical solutions for issues such as downtown redevelopment, land management strategies, evaluation of development potential, growth management, community revitalisation, brownfield redevelopment, military base reuse, provision of low-cost and affordable housing, and asset management strategies, among other matters. A wide variety of public, private, and nonprofit organisations have contracted for ULI's advisory services.

Each panel team is composed of highly qualified professionals who volunteer their time to ULI. They are chosen for their knowledge of the panel topic and are screened to ensure their objectivity. ULI's interdisciplinary panel teams provide a holistic look at development problems. A respected ULI member who has previous panel experience chairs each panel.

The agenda for a five-day panel assignment is intensive. It includes an in-depth briefing day composed of a tour of the site and meetings with key local representatives, a day of hour-long interviews of typically 50 to 100 key community representatives, and two days of formulating recommendations. Long nights of discussion precede the panel's conclusions. On the final day on site, the panel makes an oral presentation of its findings and conclusions to the local stakeholders. A written report is subsequently prepared and published.

Because the sponsoring entities are responsible for significant preparation before the panel's visit, including sending extensive briefing materials to each member and arranging for the panel to meet with key local community members and stakeholders in the project under consideration,

participants in ULI's five-day panel assignments are able to make accurate assessments of a sponsor's issues to provide recommendations in a compressed amount of time.

A major strength of the programme is ULI's unique ability to draw on the knowledge and expertise of its members, including land developers and owners, public officials, academics, representatives of financial institutions, and others. In fulfillment of the mission of the Urban Land Institute, this Advisory Services panel report is intended to provide objective advice that will promote the responsible use of land to enhance the environment.

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Acknowledgements

THE PANEL THANKS THE CITY of Wuhan, especially Chen Ruifeng (vice party secretary of Wuhan Municipal Government and party secretary of Changjiang New Town Administration Committee), Zhang Wentong, Liu Shibao, Shen Tao, and Sha Zhigui.

The panel would also like to thank Vincent Lo and the entire team at Shui On Land, including Stephanie Lo,

Albert Chan, David Wong, Alex Wang, Marina Chen, Leo Lin, Shannon Shan, Bob Wei, and Ted Tian.

Finally, the panel wishes to express its thanks to the more than 30 individuals who participated in the interview process associated with this assignment.

Contents

Panel and ULI Project Staff6

Background and the Panel’s Assignment7

The Smart City of the Future: Transport10

The Smart City of the Future: Net Zero.....12

The Smart City of the Future: Community and Housing21

The Smart City of the Future: Planning and Design.....25

The Smart City of the Future: A City of Innovation.....31

The Smart City of the Future: Finance and Governance.....35

Conclusion36

About the Panel37

About ULI Project Staff42

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Background and the Panel's Assignment

THE CITY OF WUHAN IS THE CAPITAL of Hubei Province in central China. With a population of more than 10 million, it is the economic and administrative centre of the entire province. The city lies in the eastern Jiangnan Plain at the intersection of the middle reaches of the Yangtze and Han rivers.

Arising out of the conglomeration of three cities—Wu-chang, Hankou, and Hanyang—Wuhan is a major transportation hub with dozens of railways, roads, and expressways passing through the city and connecting to other major cities. Because of its key role in domestic transportation, Wuhan was sometimes referred to as “the Chicago of China” by foreign sources. It is also a focal point for the “rise of central China” national strategy.

Wuhan is an important centre for economy, trade, finance, transportation, information technology, and education in China. Its major industries include optic-electronic, automobile manufacturing, iron and steel manufacturing, pharmaceuticals, bio-engineering, new materials industry, and environmental protection. Wuhan Iron and Steel (Group) Co. and Dongfeng-Citroen Automobile Co. Ltd. are headquartered in the city.

Thirty-five higher educational institutions make Wuhan a leading educational hub for China. Such institutions include the well-known Wuhan University and Huazhong University of Science and Technology. More than 1 million students are currently enrolled in universities in the Wuhan area.

Wuhan's hi-tech industry is primarily located in Donghu New Technology Development Zone, a New Technology Development Zone created in 1988. In 2011 it was designated as a New Technology Development Zone for optical technology and since then self-labelled as the Optics Valley of China. It has 143 factories and research institutes

related to research, development, and commercialisation of optical technology.



Global and regional maps.

The city government's long-term urban planning goals are to simultaneously undertake several discrete development initiatives that focus on different geographic locations, each with its own emphasis. The city has designated this approach as an urban spatial arrangement of "1 main city + 3 sub-cities + 3 new cities." One of those new cities is the primary subject of this report.

Study Area and the Panel's Assignment

Although the city has several economic initiatives, including automobile production and optical research, the ULI panel was specifically asked to provide strategic advice on the creation of the Changjiang New Town (Yangtze New Town; sometimes referred to hereafter as New Town) north of the central business district at the confluence of the Yangtze and bounded by Daoshui River to the east, Sheshui River and Fu River to the west, and National

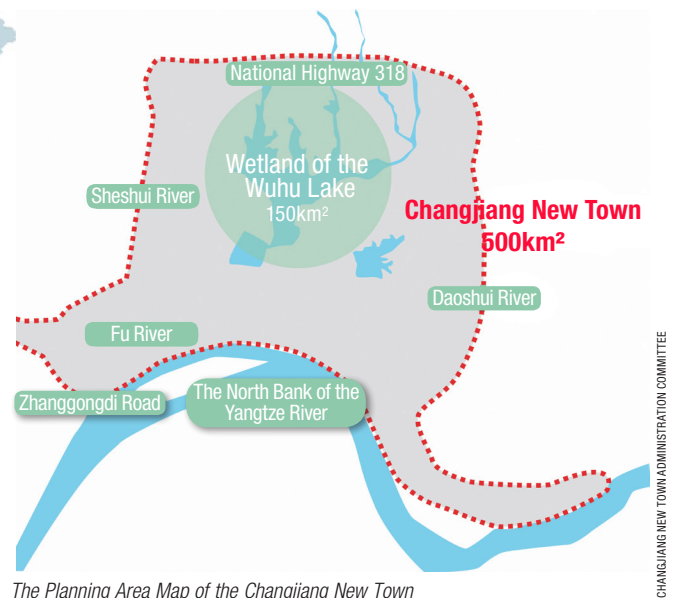
Highway 318 to the north, with a total planned area of 500 square kilometres.

The panel was specifically asked to provide advice and recommendations about what framework to use when considering the establishment of the New Town; that is, what should be the physical, social, and organisational underpinnings of this endeavour.

Smart City of the Future: A Vision

The "smart city of the future" will not just materialise by happenstance. It will require focus and commitment by the government, the development community, and the citizens of Wuhan. The approach will require long-term dedication to supporting and encouraging new systems, management, and an intentional focus on ensuring new innovations and technologies become the regular order of business for the city.

Wuhan can look to numerous examples from cities around the world for inspiration. Worldwide, cities are looking to new innovations and technologies in terms of transportation, energy, waste disposal, water reclamation, and architectural design to help redefine the urban form. Using these examples and comparators will help, but the panel believes it is also important that Wuhan find its own way,



which will require a number of pilot projects to determine the feasibility and sustainability of various approaches. Wuhan should not be overly cautious and should expect that along the way (over a ten-year period) some things will work and some will not. The city should not be afraid of failure; it should instead encourage innovation.

The Panel's Primary Recommendations

The smart city of the future must meet the following goals:

- Put people first;
- Design and create a multimodal, green, and renewable transportation system;
- Conceive, design, build, and operate around the concept of "net zero" for energy, water, and waste;
- Achieve and maintain a community that enjoys one of the highest happiness rankings among the major cities in the world;
- Design and implement a land use plan that considers an ecological framework, rather than just an infrastructure framework;
- Design and implement a community-centric land use pattern rather than a transport-centric land use pattern
- Design and implement districts that support diversity of uses in scale and identity;
- Create a flexible and responsive city fabric;
- Create a location that can successfully attract and retain talent;
- Develop communities that act as an economic engine;
- Support lifelong learning as a core component of each of the individual and the combined districts; and
- Provide the civic leadership and intentionality that will achieve the highest level of return for the New Town.

The following sections of this report enlarge on these basic recommendations for the smart city of the future.



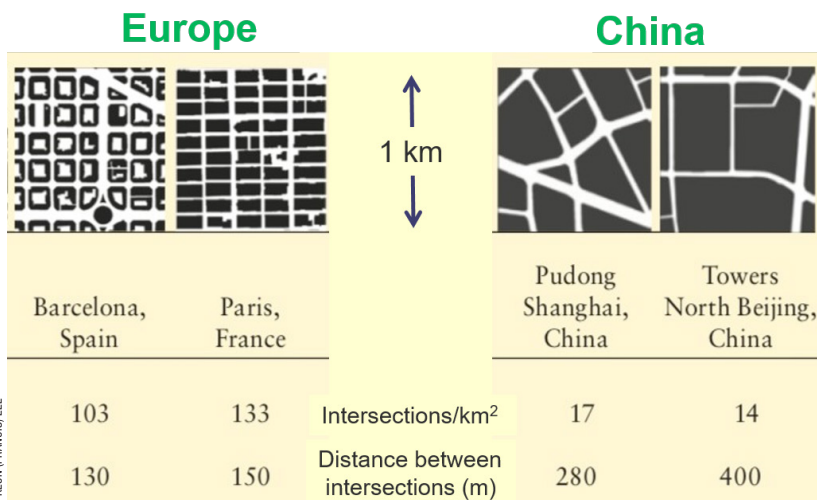
The Smart City of the Future: Transport

TRANSPORT FOR FUTURE CITIES should be human-oriented, green, and smart as well as integrating innovations and continuously advancing technologies. For a global exemplar of the city of the future in Changjiang New Town area, the panel recommends the following approaches.

Move from a Vehicle-First to a People-First Approach

Chinese cities are very much car-oriented. Roads are too wide to cross, and traffic signals are not well observed. These characteristics will be big obstacles to becoming a world-class future city. The panel recommends building multiple, narrower roads instead of single wide roads. The panel recommends limiting the width of roads to 20 to 25 metres at most (excluding regional trunk roads). This approach will increase the number of intersections and improve contact between residents.

This graphic shows a comparison between street patterns in selected European and Chinese cities. Narrower roads, closer intersections, and more compact block design allow increased human contacts and an atmosphere of sharing among drivers, pedestrians, and cyclists.



IN KEUN (FRANCIS) LEE

The road space should be shared by drivers, cyclists, and pedestrians of all ages, providing bicycle lanes and space, facilities for older people and persons with disabilities.

Encourage Efficient Public Transport

A good public transport system is crucial in making a city greener by reducing energy consumption and carbon dioxide emissions. The panel recommends considering a world-class public transport system that is comfortable, safe, fast, reliable, and even affordable. A good public transport system may increase total commuter share to 75 per cent. The panel suggests New Town residents should be able to reach public transport nodes within five minutes and the major city centres, such as airports and regional railway stations, within 20 to 30 minutes. Please consider building express rail connections between the future New Town and the airport and Wuhan Railway Station.

Public transport stations will become neighbourhood centres and provide smooth transfers. The periphery of the transport nodes should be developed with high density and include mixed functions. Mixed land uses, such as housing, working, shopping, and leisure, reduce the need for travel and travel distances. This approach enables people to walk and cycle, making the city more liveable. If housing and working areas are separated, traffic increases and public transport ridership will vary according to time and direction, causing inefficiency in public transport. Higher development density along the public transport corridor is recommended. The higher density contributes to increase public transport ridership, thereby achieving an efficient and greener city.

In addition, some room may exist for increasing the density of urbanised core areas, particularly along the subway corridor. The current subway together with future expansion

will reshape Wuhan significantly. Wuhan needs to be more cautious about rapidly expanding physical boundaries of urban areas and to consider optimising already developed urban areas.

Together with providing a good public transport system, the panel recommends reducing private car use by minimizing private car ownership and limiting parking spaces. This can be achieved through the judicious consideration of private car-free zones.

Plan for Cutting-Edge Means of Transport

Recent developments in transportation technology are remarkable. Previously unimagined technologies are being implemented, and the pace of this development is expected to accelerate. Electric cars, unmanned vehicles, and drones can contribute to make transit safer, greener, and more efficient. A global exemplar of the city of the future like Changjiang New Town should apply innovative latest technologies proactively and even welcome developing technologies for demonstration in New Town. The panel recommends introducing an electric automated shuttle bus (instead of conventional bus) for public transport and sharing self-driving cars in neighbourhoods. Residents can identify the availability of a bus or a car before starting their journey through computers or smart phones, shortening travel time.

Combustion cars will disappear in the future. To accelerate the phenomenon, New Town may introduce combustion vehicle-free zones. Until now, movement of people or goods in cities has been primarily through surface transit. However, open air may be used in the future for transit through the rapid development of drone technology. Currently drones are used to deliver things or parcels, but they can be used for personal transit purposes. The panel recommends considering spaces for drones, such as stations, during New Town construction. Technology advances very fast these days and may result in changes in physical structures. Any physical structures should be built to accommodate future changes.

Smart Transport System: Dubai Trial Deployment

Dubai's Roads and Transport Authority has been considering the broad deployment of autonomous vehicles. The vehicles, each capable of carrying ten people, operate on a 650-metre track in the business district and have previously been tested at Dubai World Trade Centre and Mohammed bin Rashid Boulevard. Such vehicles would move people to and from metro stations, from malls and tourist spots to business centres, residential complexes, and parks with a high degree of efficiency and in relative comfort.

An example of autonomous ground pods, which offer a vision of one of the likely modes of transportation in the city of the future.



WIKIMEDIA COMMONS



ROADS AND TRANSPORT AUTHORITY (DUBAI)

The Smart City of the Future: Net Zero

THE SMART CITY OF THE FUTURE will use urban design, planning, governing policies, and infrastructure that achieve net zero in terms of energy, water, and waste. In the city of the future, residents and businesses will have energy that is always available, almost free, and to-tally clean. Water for household and commercial use will be clean, wastewater will be put back into the ecosystem cleaner than when it was withdrawn, and rainwater will be captured and mitigated before it creates a flooding or contamination hazard. In the city of the future, all waste will be disposed of properly and turned into raw material for industry, renewable energy to support the community, and safe fertiliser to help provide healthy food for the community.

To achieve the city of the future, New Town will need to develop an energy infrastructure that is flexible, dynamic, efficient, and resilient—one that relies on efficiency and renewable energy to achieve net-zero pollution and seamlessly incorporates break-through energy technology as it is developed. New Town's water system will need to start with water conservation and water treatment at the building level and leverage Wuhan's ambitious "sponge city"

strategies and natural ecology of wetlands to help return water to the ecosystem free of pollutants. To turn waste into a resource and achieve net zero, citizens will need to play an active role in directing their waste to the most productive use and leverage organic wastes to produce fuel to support the cities' sustainable infrastructure.

The Case for Zero

As a city of the future, New Town will want to be a place in harmony with nature and a place where innovative technology and smart planning help reduce the impact of the community on our planet.

In November 2014, President Xi Jinping made a commitment to addressing climate change by reducing greenhouse gas emissions: China would reduce carbon emissions 60 to 65 per cent per unit of gross domestic product from 2005 levels by 2030, increase forest stock by 4.5 billion cubic metres, and ensure 50 per cent of new construction was green buildings by 2020.

China made these commitments not only to address the long-term threat of climate change, but also because

Definition of Net-Zero Community

A *net-zero community* is a community with zero net energy consumption, meaning the total amount of energy used by the community on an annual basis is roughly equal to the amount of renewable energy created on the site, or in other definitions by renewable energy sources elsewhere. These communities consequently contribute less overall greenhouse gas to the atmosphere than similar communities. The zero-net-energy consumption principle is viewed as a means to reduce carbon emissions and reduce dependence on fossil fuels.



Resilient

Able to withstand shocks and stresses



Smart

Enabling smarter buildings, smarter transportation and communication
An infrastructure that empowers a city of knowledge



Sustainable

Net-zero water, waste, and greenhouse gas emissions
2050 sustainability



Flexible. Scalable. Adaptable

Built for the near future, but enabling the future of 2050

UL PANEL

pursuing efficiency and renewable energy can help communities and businesses control their long-term energy costs. In a city of the future, energy efficiency, renewable energy, and a smart grid can reduce energy costs to near zero while providing a better level of quality and reliability than a traditional energy grid.

Achieving net-zero energy, water, and waste will also make the city of the future a healthier, happier place. Smarter buildings will not only be more energy efficient, but they will also ensure that the indoor air is healthier than the outdoor air. Smart water systems inside New Town's buildings will make sure that water is used efficiently and that it is safe to drink. Developing a "sponge city" that controls water runoff will help the city reduce water pollution and make it safer and more resilient to extreme weather events like floods.

The pursuit of net zero will also help drive the "smart city" to continue pursuing ambitious technologies and strategies to generate, distribute, and conserve energy and resources. The city's innovative technologies and ambitious sustainability goals will attract scientists, technology companies, and venture capital to develop innovative solutions to help the city achieve its bold commitment to energy and the environment.

Building the Sustainable Energy Infrastructure of New Town

To deliver inexpensive, reliable, adaptable, and clean energy to New Town, every building in New Town will need to play a role in generating, storing, sharing, and managing energy. Buildings will need to generate as much renewable energy as they consume (a net-zero "nanogrid"), be seamlessly connected with district-level energy systems (the "microgrid"), and be supported by the energy infrastructure of Wuhan (the "macrogrid").

By developing a flexible, scalable grid, New Town will make the grid more reliable and resilient: if part of the grid goes down or an innovative technology fails, the rest of the grid can quickly adapt and repair itself. Microgrids also allow for more innovation and experimentation; as new technolo-

gies are developed, they can be easily integrated into the level of the grid where they can have the greatest impact (nano, micro, or macro) without completely redesigning the infrastructure of the entire system.

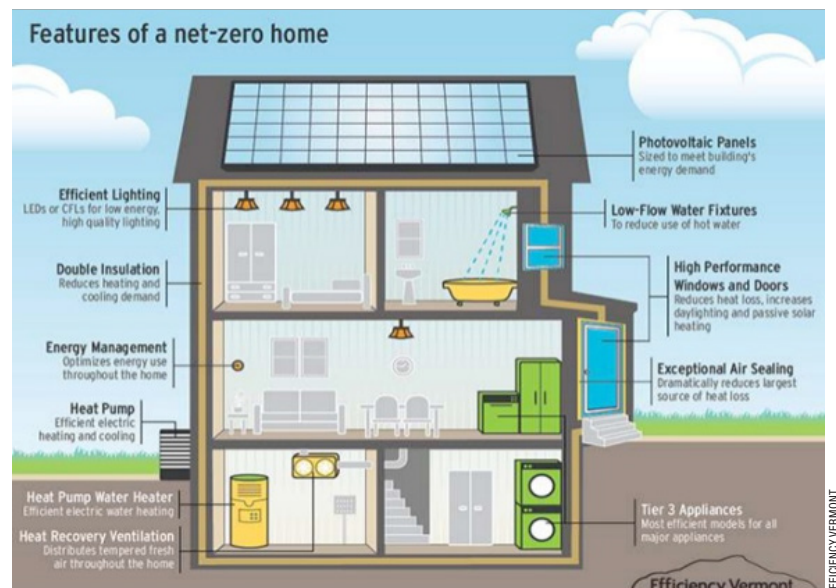
Net-Zero Nanogrid Buildings

Wuhan's buildings can do their part in delivering on net zero through the following design principles.

Start with Efficiency. The first step to achieving net zero is to make buildings as efficient as possible. Existing technologies in lighting (LED lights, better use of natural light); heating and cooling (efficient air conditioners, heat pumps, ground-level geothermal heating and cooling); and the building envelope (extra insulation, next-generation efficient windows) can make new buildings more than 50 per



On-site energy production and energy storage along with efficient energy management are hallmarks of a net-zero building.



cent more energy efficient than buildings constructed as recently as ten years ago. (A building built to high energy-efficiency standards is 53 per cent more efficient than a building built to 2009 code in the United States.) Buildings can also leverage design principles associated with the concept of passive building, focused on a building's orientation and insulation to drive even more energy efficiency. (Passive House Institute US, www.phius.org/home-page, has programmes, examples, and resources that could be helpful in this approach.)

Generate as Much On-Site Renewable Energy as Possible. Every building in New Town should generate a portion of its electricity on site, from solar energy systems (rooftop panels, solar glass, solar pavement), wind energy,

biomass (generating methane from organic household waste), and other evolving energy technologies. The type of renewable energy system used by the building should fit the building's use. A restaurant or a residential tower may generate more of its energy from biomass systems, whereas a train station or warehouse may get the majority of its on-site renewable energy from solar and wind.

Provide On-Site Energy Storage. To support the district-level energy system (the microgrid), each building should be able to store energy on site. Currently the most cost-effective energy storage systems are batteries, fuel cells, and ice storage—systems that allow a building to buy and store energy when it is inexpensive and then either use this energy or “sell” it back to the grid when energy use is high and the price of electricity would increase. As the city of the future develops new technologies, these can be integrated into the building-level system to improve efficiency.

Integrated Solar Roofing Systems

Tesla and Panasonic have developed an integrated solar roofing system that generates renewable energy from roof tiles. For the average home in the United States, this provides enough energy to offset most of the household's total energy use. Combined with a Tesla “Powerball” home energy battery and aggressive energy efficiency, this home can be net-zero energy, while reducing monthly electricity bills to near \$0.



Make the Buildings “Smart” and Connect Them to the Microgrid. Using a combination of sensors, building controls, and automation, homes, offices, and retail outlets can draw energy from the larger grid when they need it, give energy back to the grid when they do not, and manage their use of energy in a way that keeps them comfortable while helping the grid provide enough energy to everyone in New Town. Smart buildings will store energy in their batteries when they are generating more than they use, use on-site energy when it is being produced, and sell energy back to the grid when it is needed the most. Smart buildings will also have smart systems that understand when and where to provide heating, cooling, and lighting (by tracking movement of people through a building) and will know when to turn on and off energy-intensive activities to help a building reduce energy costs (whether this is running a clothes dryer, a trash compactor, or a building's boilers).

To encourage the smart connection to the grid, New Town can provide building owners with the technology for free (or lease it to them at a very low rate), with a contract that allows the energy grid to automatically control some elements of that building's energy use (dimming the

lights, turning down air conditioning, or drawing down the building's battery to support the grid during times of peak energy demand). The money saved by the grid associated with reducing demand should be more than enough to pay for the technology, and building owners will accept some limited intervention by the grid if it makes their buildings smarter, more efficient, and less expensive to operate.

A Smart, Resilient District-Level (Micro) Grid

New Town's electricity grid should be modelled after its building-level grid—designed in a way that is energy efficient, integrates renewable energy, provides energy storage, and includes an intelligent system (sensors and metres, analytics, and automation) that helps it ensure everyone has clean, abundant, secure energy.

District-level microgrids can bring additional larger-scale renewable energy resources into New Town from larger renewable energy sources such as community solar arrays (over a public space or park), as well as base-load power that is available around the clock, small-scale hydropower from the nearby rivers, biogas (methane from sewage treatment facilities), or biomass (from clean waste-to-energy facilities). These microgrids can also leverage the batteries in New Town's buses and delivery vehicles as a

“distributed energy storage system,” charging up these public vehicles when energy is inexpensive and relying on their energy-storage capabilities should the local grid need backup power.

Driving Sustainability at the Wuhan Level: Off-Site Power Sources

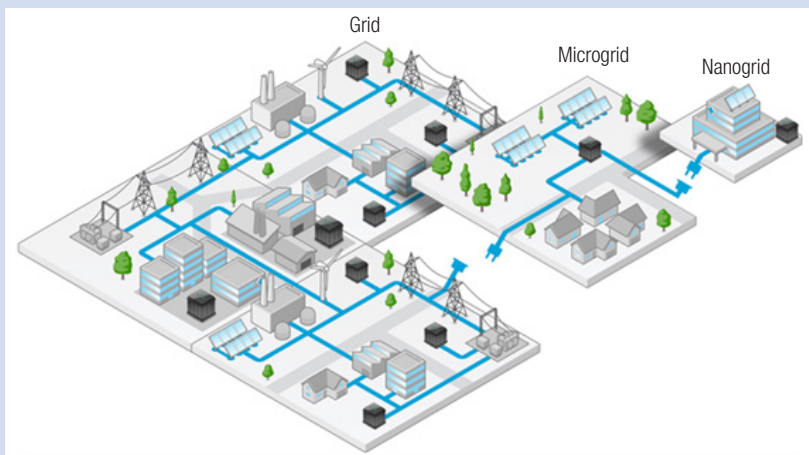
To ensure New Town's achievement of net zero, the city should work with Wuhan's larger electricity grid to make a long-term purchase of renewable energy. Ideally this energy would be in the form of wind or solar, sourced from a location near Wuhan where it would be less expensive to develop large-scale renewables. An alternative source of low-carbon energy through the grid could come from a long-term contract to purchase power from a municipal biomass power plant, a nuclear power plant, or a larger hydroelectric facility outside New Town.

If New Town can achieve net-zero energy, it will also allow the town to occasionally be an exporter of electricity. If New Town can be net positive energy on some of the highest energy demand days, it will be able to sell power to Wuhan's electricity grid at a very high price, providing additional revenue to invest in new technology or subsidise residents and building owners' energy rates.

Example of a Microgrid

Homes and buildings (the nanogrid) are connected to each other and to larger power sources through a small-scale, shared electricity grid (the microgrid). This provides them with more possible power source options and real-time distribution, which ensures that enough electricity is always available and is produced in an efficient, affordable way. These microgrids can be connected to each other and to the larger grid to provide even better cost savings and overall reliability for the energy system.

Buildings work with community-level power generation, distribution, and storage to use energy efficiently and achieve net zero. District-level improvements include new technologies such as kinetic streets, microgrids, and electric vehicle infrastructure.



AQUION ENERGY

Financing the Grid of the Future

While a net-zero energy grid will reduce building owners' long-term energy costs, building the grid of the future will require significant upfront capital costs. New Town can pursue several strategies to finance this system:

- New Town can be the owner of the microgrids and can have residents sign long-term power purchase agreements to cover the cost of renewable energy, energy storage, and grid services. Residents pay nothing up front for solar panels, energy storage, smart thermostats, and smart appliances, but they sign a long-term contract (possibly ten years) to pay a “smart city” fee on their utility bill each month. The smart city fee and the monthly energy bill for these buildings should be lower than what these same owners would pay in a similar building with a traditional grid.
- New Town could attract third-party financing through bond issuance or an equity stake in its microgrid system. An investor would provide capital for the necessary components of the microgrids and would be paid back over time from the cost savings associated with the grid.
- To improve the economics of the debt, equity, or long-term lease financing, building owners could offer utilities some control over their systems during peak demand events—allowing the utility to ramp down their energy use or draw down their energy storage devices when power is in greatest demand. By providing demand response, residents would significantly reduce the microgrid's cost (because it would avoid building new power plants or buying power from Wuhan's overall grid when it was most expensive).

Living in Harmony with Water

Wuhan is a city of lakes and rivers. Water is the area's greatest resource but also one of its greatest challenges and potential threats. Finding a harmonious balance between New Town and its water resources will be a critical component in developing the city of the future. The guiding principle for New Town's water strategy should be

net-positive: that any water used by New Town's residents goes back into the ecosystem cleaner than it was before it was used and that rainwater that falls on New Town's buildings and streets is quickly absorbed or filtered before it enters Wuhan's lakes and rivers.

As with energy, a net-positive water system can reduce the short- and long-term costs of water to building owners and to the community by reducing the costs associated with pumping, treating, and storing water and by decreasing the physical damage and economic disruption caused by flooding and other extreme water-related events.

New Town's municipal water management should mirror its energy management. Buildings should be equipped to capture, treat, use, reuse, and recycle as much water as possible on site. District-level water systems should be used to more effectively manage both wastewater and stormwater, returning it to the lakes and rivers cleaner than when it arrived in the faucet or on the sidewalk.

New Town's stormwater management should be connected to its overall land use strategy. Areas within the 500-year floodplain should be reserved for parks and natural space. The wetlands should be preserved and enhanced to protect against flooding and naturally treat wastewater, and the city itself should be designed to mitigate the impacts of a 500-year flood or rain event.

Use Water Efficiently and Responsibly in New Town's Buildings

The first step in developing a net-positive water management system in New Town is using water efficiently in the community's buildings. Buildings should be designed to capture rainwater (with rain barrels, cisterns, and the like) and to use this recycled rainwater in conjunction with graywater systems for water uses that require minimal treatment (irrigation, landscaping, toilets). Buildings should be equipped with water sensor technology (to quickly identify and correct leaks) and efficient fixtures and appliances to use water responsibly. Opportunities should be explored to treat water on site before it leaves a building; for example, solid waste can be separated from water

and combined with food waste in a methane digester to provide supplemental building power (and generate inert, safe fertiliser), and graywater from the building's sinks can be diverted to the building's toilets before ultimately being sent off site.

Leverage Ecosystem Services to Treat Water Efficiently and Effectively

Water that is not captured at the building level will need to be treated through New Town's wastewater infrastructure. This should be a dedicated system of pipes that move the water separately from stormwater to a dedicated treatment area. In treating wastewater, New Town should leverage the local ecology to cost-effectively and naturally filter the water. Wastewater-dedicated wetlands (separate from the rest of the ecosystem) can significantly reduce the cost, energy, and chemical use of water treatment by naturally pretreating wastewater before it goes into a wastewater treatment facility. These wetlands can supplement natural wetlands, providing some carbon capture and storage as well as wildlife habitat benefits in addition to their impact on water treatment. The panel recommends that the government authority research the use of dedicated wetlands and other natural pretreatment systems. One source to consider is http://www.wastewatgardens.com/pdf/WWG_AboutConstructedWetlands.pdf.

China's "sponge city" initiative aims to arrest the cycle of waterway degradation and flooding through the use of permeable surfaces and green infrastructure.



Stormwater Management—Taking “Sponge City” to the Next Level

While using water efficiently and responsibly will reduce New Town's impact on its environment, effectively managing stormwater will be essential to protect the community from extreme weather events.

Wuhan has a history of flooding, and as part of the impacts of climate change, the frequency and magnitude of extreme weather events are likely to increase. New Town's buildings and infrastructure need to take the following steps to mitigate the impacts of stormwater:

- **Avoid building in the floodplain:** With the increase in extreme weather events and their magnitude, what was once a 500-year flood event may become a 50-year flood event, and the 100-year floodplain may be underwater every other year. New Town's buildings should be set back to the 500-year floodplain wherever possible, and the city's green space (parks, recreational facilities, and natural space) should be located near the floodplain to provide a natural buffer for flooding and extreme weather events and to help filter stormwater before it reaches lakes and rivers.
- **Absorb as much water as possible where it lands:** Wuhan has adopted an ambitious “sponge city” strategy—leveraging raingardens, bioswales, and permeable pavements to absorb rainwater and reduce flooding. New Town should embrace these strategies and leverage green roofs, cisterns, and rain barrels to help capture stormwater, possibly putting it to use on site before it returns to the ecosystem.
- **Design buildings and critical infrastructure with flood resilience in mind:** Even if New Town takes significant measures to avoid floodplains and capture rainwater through sponge city strategies, a strong likelihood still exists that extreme weather events will result in city flooding. To reduce the impact of flooding, New Town should at minimum move critical infrastructure (power generation, management, and energy storage,

critical transportation arteries, and so on) above any possible floodplain, either by focusing them on higher ground or elevating them to higher floors in a building, or by using an elevated grade for a road or track.

Turning Waste into a Resource

Managing waste is a key component in making New Town a net-zero community. Waste generation has significant environmental impacts, and waste disposal can impose ever-increasing costs on a community. Alternatively, waste reduction, reuse, and recycling can reduce costs across the production chain, and well-managed waste streams can generate income for the community by turning waste into raw materials for future products or into energy through a biogas digester or biomass incinerator. New Town will manage its waste as a resource, reducing waste generation and ensuring that all waste becomes a feedstock for future production or an energy source to support the community's net zero goals.

Reduce Waste Generation

The first step in achieving net zero is to provide a system that encourages building owners and community members to reduce waste generation. This goal can be achieved through banning certain products from the community (such as plastic bags and bottles) or through waste disposal pricing that encourages waste reduction. All community members should pay for waste disposal based on the weight of waste produced, and the community should determine waste disposal pricing based on the level of financial incentives necessary to drive waste reduction to a reasonable level.



EXCLUSIVENCHES

Encourage Recycling and Waste Diversion

Residents should be charged a significant amount for waste disposal, but they should be provided with a range of incentives for waste diversion and recycling. Valuable feedstocks for other industries (metals, cardboard) should be easy for residents to recycle and should generate some positive income for these residents. Community members should also have the technology to easily divert solid waste (food waste, human waste, and other organics) to building-level or district-level biodigesters, which generate methane gas as a supplemental district power source and safe, inert fertiliser that can be used for a combination of agriculture and public park uses. (Several biodigester case studies can be found at https://colab.mit.edu/sites/default/files/D_Lab_Waste_Biodigester_Case_Studies_Report.pdf.)

Use Waste Wisely as a Critical Power Source

Any waste that cannot be reduced, diverted, or recycled can still be used as an energy source—through a biomass

Biomass Energy Plant

Copenhagen has developed what may be the most sustainable biomass energy plant in the world. The plant's state-of-the-art pollution-control technology ensures that no harmful air pollutants are released, and the operation of the plant is so innocuous that designers were able to turn it into a public park—complete with a ski slope and recreation centre. (More can be found at <https://inhabitat.com/big-unveils-a-waste-incinerator-ski-slope-for-copenhagen/big-ski-slope-waste-incinerator-7/>.)



BJARKE INGELLS GROUP

incinerator. Biomass is technically a renewable resource, but it needs to be managed responsibly to avoid negative environmental impacts. New Town should include a sustainable, environmentally friendly biomass plant to turn excess waste into fuel. If New Town is extremely successful in its waste reduction, recycling, and diversion efforts, this biomass power plant may even be able to import waste from neighbouring communities in Wuhan and safely turn this waste into energy.

Leveraging New Town's Sustainability Goals to Drive Innovation and Investment

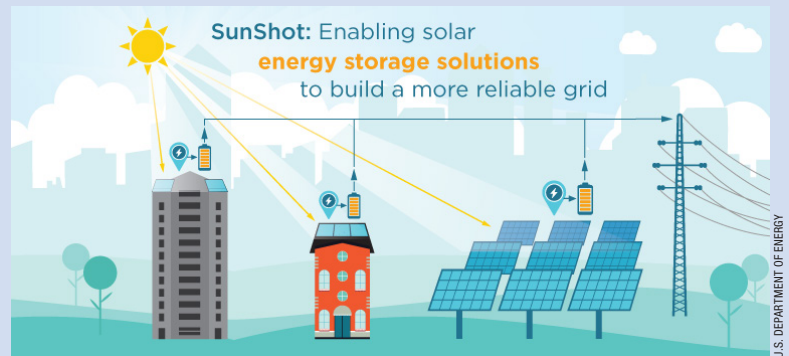
Achieving net-zero energy and waste and net-positive water use would make New Town the most sustainable community on Earth and generate tremendous recognition from the international community. Although some buildings have achieved net-zero energy, water, and waste, no community of this scale has yet made it to the same ambitious level.

However, even the pursuit of these net-zero goals can spur excitement, innovation, and investment in New Town. Scientists looking for a breakthrough energy efficiency and renewable energy strategy will want to be located in a community working towards transformative sustainability goals. Companies developing energy, water, and waste technologies will want to use New Town as a laboratory to test innovative new technologies and strategies and as a showplace for their sustainability technologies. And companies that see the multiple benefits that come from a pursuit of net zero (lower energy and water costs, more resilience from natural disasters, the ability to attract the workforce of the future) will want to relocate to be part of this ambitious project.

The drive to zero can be accelerated through the development of a breakthrough sustainability technology incubator in New Town. Possibly associated with and colocated with a new university or research institution, this incubator can support entrepreneurs, connect them with capital, and help them move from concept to prototype that can be tested in a real-world application in the town itself.

U.S. Department of Energy: Accelerating Development of Next-Generation Sustainability Technology

The U.S. Department of Energy (DOE) has sponsored two programmes to accelerate the development of next-generation sustainability technology. DOE's Sunshot initiative helped double solar deployment in the United States while helping cut the cost per watt of solar in half. DOE's ARPA-E (Advanced Research Projects Agency—Energy) programme has awarded \$1.5 billion in grants for breakthrough sustainability technologies and science. Projects have created 56 new companies, generated more than \$1.8 billion in follow-up private sector financing, and led to more than 200 patents. (More can be found at <https://energy.gov/eere/about-office-energy-efficiency-and-renewable-energy>.)



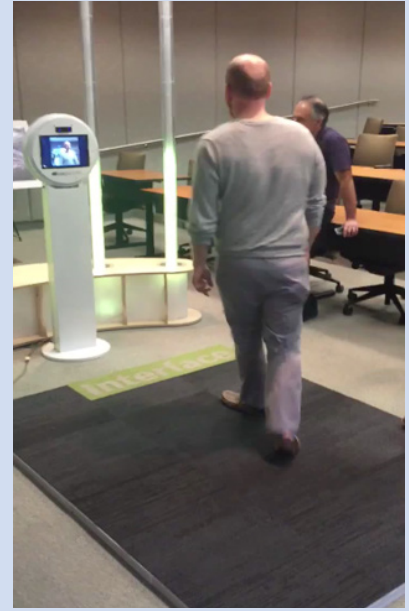
The government should also consider sponsoring a sustainability technology challenge for net-zero technologies, awarding a large cash prize or important scale-changing procurement contract to deploy the technology across Wuhan or across the entire province. This type of competition could attract worldwide attention and applications, which would increase the visibility and interest in New Town's ambitious sustainability goals.

Other Considerations for Sustainability and Resilience

A variety of other sustainability and resilience concepts and initiatives should be considered as part of New Town's development in Wuhan. In the short space of time that the panel was in Wuhan, it was just not able to delve deeply into these subjects. Following is a list of potential subjects and concepts that should be considered by the government authority as the New Town framework is prepared:

Kinetic Energy Sources: Piezoelectricity—Turning Friction into Power

Piezoelectricity is a kinetic energy generated by compressing material that vibrates on horizontal surfaces. In recent years, several attempts at macro-scale application of piezoelectric technology have emerged to harvest kinetic energy from walking pedestrians. Two pilot projects underway are located at Hartsfield–Jackson Atlanta International Airport and NASA's Kennedy Space Center. As part of the framework planning for achieving net zero for New Town, special focus on the walkable, vibrant public spaces in New Town's various neighbourhoods should consider installing this new technology.



- Battery and fuel cells;
- Underground contamination;
- Self-driving delivery robots;
- Superheating and melting trash and using resulting heat for power generation;
- Avoiding obsolescence; and
- Technology demonstration hub—put your tech into operation in pilots.

The Smart City of the Future: Community and Housing

TO PUT PEOPLE FIRST, the panel recommends that Wuhan Changjiang New Town strive to build a community that enjoys one of the highest happiness rankings among the world's major cities.

To achieve this goal, the community must be one that is harmonious, gracious, and cohesive, with people living in affordable, comfortable, and smart homes and enjoying a high quality of life. The living environment is liveable, vibrant, clean, green, resilient, well connected, safe, and sustainable. The people embrace diversity and inclusivity, possess a strong sense of participation and ownership, live active and healthy lifestyles, and uphold lifelong learning; and they are considerate. They are served by a total living environment—not only the hardware, but also the software—including high-quality and accessible social, utility, and lifestyle services.

Overall, New Town will have to address in totality the social, economic, and environmental dimensions of sustainable development.

How Urban Design Facilitates Social Harmony

New Town targets attracting young talents, including alumni of Wuhan universities who are working elsewhere, talents returning from overseas, and foreigners. Existing populations who will be affected by redevelopment will likely continue to live within the New Town boundary

through rehousing. Because a large proportion of these people will not be Wuhan natives, integrating them with the locals is crucial, instilling in them a sense of belonging and encouraging them to sink roots in New Town for the long term. Diverse backgrounds of people living in proximity can be a source of annoyance, tension, or conflict. So how could New Town address the challenges of social harmony among its residents and make their families feel happy while living here?

To make people truly happy, thoughtful urban design is as important as vibrant economic development and good social governance. In his thought-provoking book *Happy City: Transforming Our Lives through Urban Design* (2013), Charles Montgomery describes how urban design can shape the way residents live and affect their happiness. Neuroscientists and psychologists have found evidence on how urban and architectural designs, including access to nature and greenery, street layout, and building facades, affect the behaviors and happiness level of residents living in a city. New Town could also take advantage of its many water bodies by making them natural water-edge friendly. A well-planned city with high-quality shared public and green spaces would provide an exhilarating environment that nurtures community bonding among its residents.

It is imperative that New Town provide a comprehensive range of efficient, effective, and accessible social services; such as education, health care, housing, and employment; utility services and infrastructure such as water, gas,

Thoughtful urban design is as important as vibrant economic development and good social governance.



GOVERNMENT OF SINGAPORE

electricity, telephone network, and Internet access; and lifestyle facilities such as banking, leisure, entertainment, sports, and cultural activities. In addition, the panel recommends that a wide range of community-centric spaces be provided in a hierarchical manner to foster interaction and integration.

Precinct Level

At precinct level, facilities such as exercise stations, playgrounds, community gardens and farms, seating areas, and community living rooms could provide intimate spaces for individuals and families to gather and interact, and thereby foster integration among them.

Neighbourhood Level

At neighbourhood level, community plazas can be provided to facilitate organisation of group activities, such as cultural events, square dancing, and group exercises. Indoor plazas can also be provided to retain vibrancy during the quieter months in winter. More important, these public spaces must be activated through programming to ensure their success. A good spread of these spaces throughout New Town and easy accessibility would also encourage people to commute to these places by walking and cycling, as part of their healthy lifestyle.

District Level

At district level, civic centres could be developed to provide one-stop service to residents for their daily needs, such as retail shops, food outlets, provision shops, banking, and government and utility services. Overall, each district should be self-sufficient. One example of this strategy is the concept of district civic centres implemented in Sino-Singapore Tianjin Eco-city, which is modified from the concept of neighbourhood centres and community centres implemented in Singapore. In the Eco-city, one district civic centre is provided for every 10,000 to 15,000 households within walking distance, with a comprehensive range of social and community services and facilities. The district civic centres have not only provided convenience to their people, but they have also created a vibrant community. This, together with the eco-lifestyle they promote, has in turn attracted many new residents to move into Eco-city.

Community Ownership

To instill a strong sense of participation and ownership, the panel recommends regular consultations and engagements with the community on issues that affect them, for example, municipal and estate management matters, and eco-lifestyle. Community feedback would help make optimal decisions for greater social good, while consensus building would motivate the community to be the driving force for adopting the decisions.

This process of finding a solution collectively will also encourage people to be inclusive, open, and considerate. People will be more appreciative and they will take ownership of the solutions, resulting in social harmony. Not forgetting that new communities could emerge on the social media and other platforms, the use of smart community applications to connect with them and to sustain outreach to the community should be an integral part of this effort.

Housing Provides Basic Building Blocks of Community

Family is the building block of community, and housing is a basic need for families. Hence, the panel recommends that New Town provide a wide variety of housing styles that are affordable and comfortable to meet different lifestyle and life-cycle needs.

To promote social inclusion and integration, a good mix of different housing types and sizes should be provided in each precinct to cater to residents of different economic and cultural backgrounds. As a strategy to attract young talents, incentives such as subsidies and preferential mortgage loans could be provided to facilitate their buying a house and sinking roots in New Town. However, given the current lack of suitable rental housing for young talents who are not yet ready to buy a house, an adequate supply of high-quality market-rental housing must be provided near their places of employment.

Because of the life-cycle nature of demographics, build-ings, and technology, a dynamic view should be adopted in city planning. In the demographic aspect, while the



GOVERNMENT OF SINGAPORE

population in New Town may consist of mainly young people and young families initially, the demographic profile will become more diverse in the long term. Young talents today will become elderly 30 to 50 years later, and their children will have formed their own families. Married children may wish to live near their parents for mutual care and support. Therefore, senior housing will need to be provided in future, and it will be congruent to provide housing for extended family and intergenerational living. These considerations must be factored into the New Town long-term plan.

Affordable Housing

Property speculation in the last decade in China has resulted in price escalation to a level that is unaffordable to young families. It has also induced overinvestment in property development, resulting in the phenomenon of ghost towns where districts of completed buildings are devoid of occupants.

At the 19th Party Congress, President Xi Jinping commented that “houses are meant for people to live in, and not for speculation.” It is opportune to pilot a new housing system to address the perennial issue of housing affordability, with the aim of attracting young talent.

New Town may study progressive housing systems in Singapore and other countries. However, it is important to consider the demand of resources of these models and modify them to suit the local context accordingly.

Estate Management and Maintenance

Buildings will degenerate through weathering, and facilities will be dated over time. Despite their attractive appearance when new estates are first constructed, many estates in China look rundown in a short span of eight to ten years from completion. The profile of residents living in older estates will also age over time. To prevent older estates from deteriorating into slums, an effective regime needs to be put in place to ensure that older estates remain aesthetically attractive and safe. Continuous reinvestment to update and rejuvenate facilities in older estates should form part of the scheme. This strategy is also crucial to instilling strong pride and a greater sense of belonging among the residents and to retain and attract younger generations to live in these older estates.

Singapore invests heavily in estate maintenance and rejuvenation; its government subsidises the main bulk of the costs to enhance the living environment of its older public housing estates. Singapore has a full range of estate renewal programmes to refurbish and modernise the physical states of buildings and facilities, from inside individual apartments, to buildings, precincts, neighbourhoods, and entire towns. This ensures that residents in public housing estates continue to enjoy a good living environment and the value of their apartments is sustained.

The panel recommends New Town implement a comprehensive estate management system:

- Enact a comprehensive set of laws and regulations to ensure smart maintenance and management of build-

These pictures show how well Singapore maintains its old public housing estates, which were developed 40 to 50 years ago.

ings and common properties for safety, cleanliness, serviceability, and sustainability and for the convenience of the residents. It should contain details on standards of maintenance and repairs, duties and responsibilities, procedures, process of resolutions, sources of funds, authorities, and enforcement.

- Set guidelines and benchmarks for building design, construction technology, and building materials for ease of maintenance, replacement, productivity, quality, and sustainability.
- Implement a roadmap for a long-term programme of reinvestment and rejuvenation as New Town matures, to keep the older parts of New Town vibrant by uplifting their living environment to modern standards.

The Smart City of the Future: Planning and Design

THE PLANNING AND DESIGN PORTION of this report provides guidance for how the transportation, housing, and sustainability recommendations previously made can be achieved. In addition to those principles, this section suggests in the context of structure, land use, and urban fabric, how New Town creates and encourages innovations in its planning that meet the following goals:

- Presents a vision and clear objectives for its future built from its context and endorsed by consensus among city stakeholders;
- Delivers diverse uses that provide lifestyle options to meet living, working, and social demands of its target market by increasing liveability and community well-being;
- Is economically active in high-value industry sectors and able to provide the workforce and infrastructure that companies in those sectors need;
- Delivers education and makes employment opportunities widely available to all people and communities; and
- Creates a healthy community through environmental conscience and nurturing of its natural resources through the delivery of networks of greenways and waterways alongside a well-planned, well-designed built environment.

New Town as the Smart City of the Future

The smart city of the future encourages and creates an innovative regional plan and urban fabric that

- Delivers a future statement in liveability for Wuhan;

- Delivers an ecological legacy showcasing the essence of Wuhan City;
- Transforms city thinking from rigid monument to dynamic place based on design and innovation;
- Connects the individual with knowledge, community, and the environment; and
- Is bold in its vision, progressive in its planning and implementation, and experimental in delivery of innovation while always learning and evolving, thereby addressing the issues of today and responding for tomorrow.

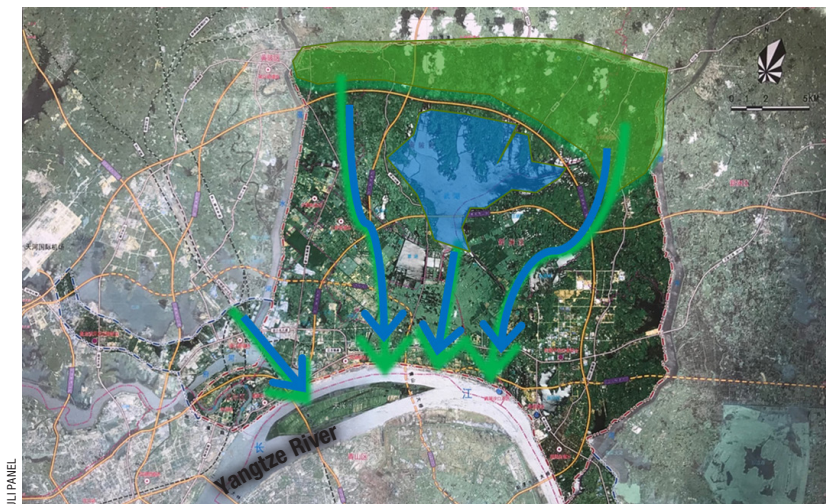
Regional Planning Principles

The city of the future for Wuhan takes its clues from the city of the past. Older civilisations in China understood the power of living in well-defined and contained areas, embraced and respected nature, and conducted commerce, recreation, and activities of everyday life in a harmonious environment. The Wuhan of today is losing its spirit of place and revealing a pattern of dense high-rise sprawl, disconnected from the land.

The panel recommends the following principles to address how to rethink the community form for this 50,000-hectare new town, learning from the past while addressing the future.

Principle 1: Create an Ecological Network That Protects, Preserves, Enhances, and Sustains New Town

The DNA of older districts and neighbourhoods within Wuhan, and indeed all of China, fostered existence in a symbiotic relationship with the larger environment. Dense pockets of residential, commercial, and public parks were organised within localised watersheds that supported natural zones of forests, streams, and water bodies and provided places for growing food.



The Green Blue network provides a framework for planning of the new town.

The panel believes the starting point for planning New Town begins with an understanding of natural systems from the hills to the north, south to the Yangtze River.

Areas of hillside slopes, wetlands, waterways, Lake Wu and other smaller lakes, and plant communities that support wildlife and provide good soils for local farming should all be protected, preserved, and enhanced. This is particularly important because many lakes in Hubei Province have been filled in the last decade, and those that remain are too polluted for recreation purposes.

These elements shape New Town's ecological framework, becoming the green and blue armatures of the urban fabric, and dictate where development can and should occur. This view is counter to the traditional view of beginning with infrastructure, plotting of land, and determinations of density. All of that happens because it must, but it becomes more meaningful and less expensive to let an ecological process determine where urbanisation is best suited.

Finally, this view is significant when thinking about climate change and resiliency. Reducing the potential effects from flooding or other natural disasters to the urbanised areas determines who wins and loses in the late 21st and 22nd centuries.

The benefits of this ecological approach to town planning are several:

- Preservation of corridors for water drainage, plant communities, and wildlife movement can connect people to the web of life and provide opportunities for education, research, and spiritual connection. These corridors naturally vary in size and may need to be 100 to 500 metres in width.
- Preservation of the hills, slopes, and valleys to the north and the lake system can define a northern urban limit on Wuhan city growth. Overall, perhaps 50 per cent of New Town's total area can be dedicated to land preservation and provide places for farming, hiking, wildlife viewing, and species research in an age of rapid climate change. The outer ring road in the northern part of New Town can serve as the limit for urbanised development.
- Establishment of farm-to-table areas for food security and everyday nutrition is vital as agricultural land is absorbed by new development. Growing food locally is not only healthy and sustainable, but it is marketable as an authentic experience for tourism within the region. Many places in the world are now experimenting with small-scale urban agriculture, allowing for food cooperatives between farmers and surrounding communities. Setting aside areas of two to five hectares in strategic locations will accomplish what is required for local production.
- The urbanised areas of New Town can connect to the ecological pattern through small-scale drainage and retention, and trail connectivity; these areas capture value by being located adjacent to a treasured resource.
- The natural network within the urbanised areas can contain public spaces that begin with wilderness areas on the edges and progress through the community to formalised parks. These spaces become the canvas for arts, cultural, and social engagement.

The panel recommends extending the Yangtze River Park eastward to the New Town area. The width of the park will vary with the amenities provided.

Create a world-class ecological park on Tianxing Zhou island in the middle of the Yangtze River. Seattle, Washington, has Discovery Park, Singapore has Gardens by the

Bay, and other cities have used waterfront edges and islands in rivers to enhance the ecological context while allowing for some human interaction that provides a green lung for environmental, educational, and spiritual well-being.

Principle 2: Develop an Urban Form for the City of the Future That Clusters Districts of Compact Mixed-Use Patterns into a Diverse but Connected City

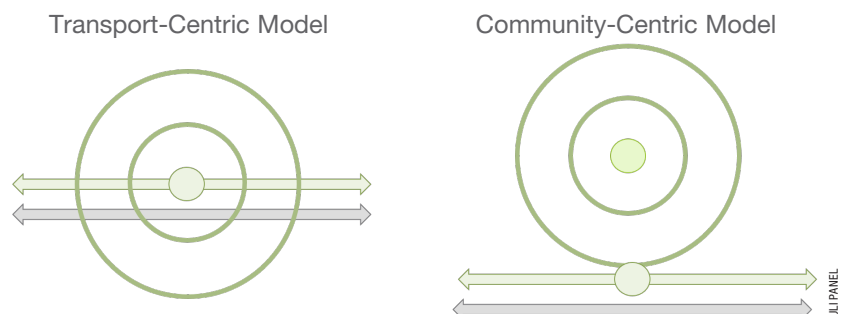
The city of the future cannot be relentless urban high-rise towers and congested road arteries extending over many kilometres. The new form should be recognisable within the larger context, have boundaries, offer transportation choices, and provide a sense of place that is meaningful to the individual. The panel recommends a clustered form of development that is contextually appropriate rather than one large central city with radiating rings of development. The clustered form responds to the ecological pattern and provides the following benefits:

- The urbanised areas should be defined by recognisable districts, distinct communities, neighbourhoods, and blocks, offering richness at the pedestrian scale. Legibility and wayfinding within an urban context are enhanced if one knows and understands where a neighbourhood begins and ends. Introducing both green and blue connections (of water drainage courses and plant communities), including trails within the urban fabric, will help in neighbourhood identification. The panel recommends thinking of a prototypical urban district that is approximately 400 hectares, or approximately 2 kilometres by 2 kilometres. A person can walk one kilometre in 15 minutes, so from the centre of any defined district, a walk of 15 minutes will lead to the edges in any direction. New Town will contain many districts, each separated by corridors for water drainage and retention, wildlife and native plant species, and places for small-scale agricultural production. The size of the district may evolve over time; however, the panel encourages Wuhan to experiment with an optimal urban clustered form.
- Each district should be located adjacent to stations for regional mass transit, access to region-serving roadways,

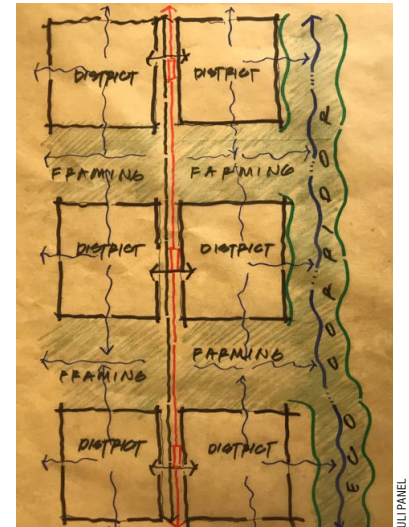
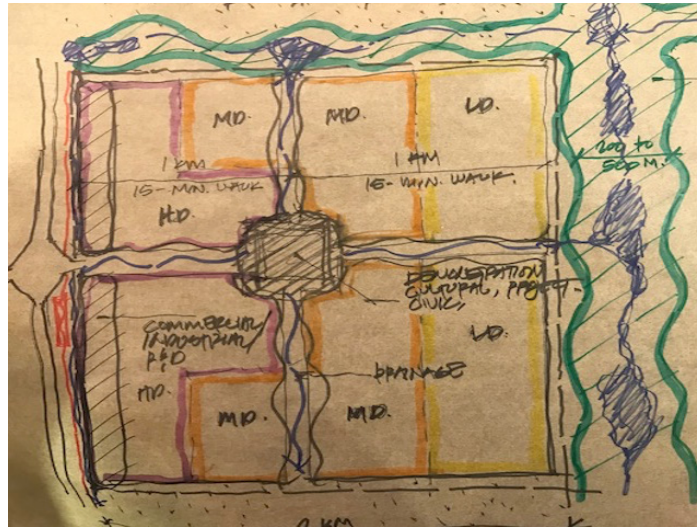
and infrastructure corridors for power generation. The panel recommends a form that places the mass transit line on the edge of the district with higher-intensity uses located next to the station, allowing both commercial intensity and residential density to taper towards the natural open-space corridors. Local-serving buses and trams can route outward from the stations through the communities and smaller neighbourhoods. By placing the rail lines and arteries at the district edge, several districts can combine to share regional infrastructure.

- Within each district open space should include 25 to 30 per cent open space, thereby allowing for parks and public rights-of-way.
- The heart of each community focuses on a specific element—civic, community, or cultural use located in the green landscape—or a centre of excellence of innovation, science, industry, or education.
- Each district may be themed or focused differently based on the mix of land uses or its core use or anchor. One district may feature a convention and hotel group of uses; another may feature a science and engineering academy or another may feature a university campus. In all cases, the intent would be to require each district to be mixed use and include all the components of a vital community: residential, commercial, retail, and parks.
- The urban fabric within each district should reflect the context in which it is located. Districts located in the south of New Town near the high-speed train and older Wuhan neighbourhoods may contain higher plot ratios, whereas those farther north, close to Lake Wuhu and the hills, may be lower in intensity of development.

The panel suggests that a community-centric model (rather than a transport-centric model) be considered for the land planning of the new town.



The large scale of the new town development suggests that each district and ensuing regional cluster support diverse uses, scale, and identity. The overarching principles of putting people first, designing with the Green Blue network, and designing for a flexible and responsive city fabric need to be considered at every level of development design, review, and implementation.



- The panel recommends the establishment of clear design principles that reinforce design excellence of built form and public domain outcomes addressing items such as height and plot ratio limits and targets, development standards creating diversity not uniformity, descaling the district into smaller parcels, and smart building setbacks shaping a comfortable environment at the pedestrian scale. Architects and landscape architects will have clear direction to deliver high-quality built form outcomes but with enough flexibility to shape their own individual project creativity and identity.
- In addition, all elements within the district—household and business, industry and education, public and private—will be connected electronically to smart energy and transportation sensors.

Principle 3: Put People First—the Human Experience at the Heart of the City—Delivering a Global Benchmark in Liveability for Wuhan and for China

The future city will reprioritise its approach to urban planning and design, shifting from an infrastructure-led approach to planning, to consider future cities at the human scale, meeting the needs, aspirations, and aims of the

individual while building communities that are coherent, contextual, and resilient.

The city of the future must put people first in planning. From the building to the community to the city, infrastructure will be delivered as a service rather than a driver, and a place will evolve that is people centred, built on community, and engaged and connected with its context.

Designed with the person as the primary customer.

Reversing the traditional approach to precinct planning, the structure for the city of the future will place the user's experience at the start of the planning process, with neighbourhood, community, and the public domain at the forefront of planning the new city.

When presenting the future vision for the city of the future, the panel recommends that any proposition be presented from the perspective of what it is like for the future citizen, the user: how they will live, where they will work, how they gain knowledge and well-being, and the opportunities provided to share and interact with their community.

For the city of the future, a knowledge city is aligned with smart/learning/progressive minds. And although talented



Wuhan Tiandi, a Shui On Land development in downtown Wuhan, exhibits many of the desired characteristics of a city of the future, including walkability, livability, accessibility, and connectivity.

young minds are a priority, the future city must provide for people from all demographics—of all ages—each with their own needs and aspirations and aligned in their shared vision for the future of Wuhan.

Walkable, liveable, accessible, and connected. The structure of the city will be broken down into understandable, recognisable, and defined communities, districts, and city clusters. At the heart of each community and each district will be car-free, pedestrian-friendly areas served by a range of future transport options, such as autonomous bus services and on-demand cars.

Each district will evolve from its community heart, through medium-scale pedestrian-friendly streetscapes to be framed with density at its perimeter. Transport connections occur at the district perimeter where people connect with the high-speed rail, the subway line, the car-parking station or networks beyond.

Within each community, on-time communications connect the individual to home and to work—to their community on and off line, to municipal services and local information, enabling them to live their life of tomorrow.

Transport is a service not the priority. The future of transportation is shifting from amenity and infrastructure to the provision of multiple options of individual, personalised, and on-demand services. Whether at the community, district, or city level, access and connection must be easy, immediate, and safe.

The panel recommends rethinking the transport connection from the heart of a cluster to its edge so the focus shifts from the mass-transit hub to the walkable, liveable,

safe neighbourhood. In the city of the future, any person is within a 15-minute connection to a tertiary transportation node—the district's smart loop. From this loop, connection is made to intradistrict connection and to main-line services to city, airport, and so on. Within the smart loop, the environment may be car free, pedestrian oriented, walkable, safe, and secure. However, that will not mean it is transit free. Each district will explore new and innovative approaches to local networks that ensure the highest degree of connection, amenity, and delivery can be provided.

Diversity for people, with a vibrant hub. The panel recommends that planning for the city of the future deliver a range of diverse opportunities, experiences, and amenities for all ages and all demographics. Although individual aspirations and economics vary, each citizen shares in the values of this knowledge-based community with access to a range of experiences and opportunities and lifestyle choices.

No district becomes a single use but a mix of uses developed across each community and neighbourhood. Districts themselves may be prioritised to a core use or anchor—university, commerce, sports centre, or the like—but in each a diversity of uses, residential and commercial, industry and amenity, remain. There are no gated communities, stand-alone office parks, and walled towns. These local neighbourhoods are connected to their mixed-use community by a public domain activated by retail streets, recreational spaces, cultural facilities, and green and blue corridors linking the communities of the district and the districts themselves.

The panel recommends that these connectors—the integral part of the ecological network that ties the city of the future together—become the public focus of the clustered city. Like the Yangtze riverfront, already a significant public place, blue/green corridors become both environmentally important and a New Town highlight. Meandering walkways alongside lakes and streams, a rich diversity of flora and fauna, places to stop, sit, and think along platforms to gather, be entertained, visit the market, or watch the light show outside Wuhan Qintai Culture and Art Center. Human experience should come before built form. Building on the premise of putting people first, the panel recommends initial planning focus less on the architecture of the buildings and more on the place and the experiences within it. This shift will ensure planners consider the design and evolution of this place from small to large, from the street to the building.

Within each district, policies, regulations, and design standards will be prepared to ensure each building adds to the liveability and quality of a neighbourhood through building design via orientation, solar access, and materiality; health and well-being; environmental performance standards; access to shops and community services; linkage to the smart loop and maximum distance to transport connections and public green space.

Principle 4: Flexible and Responsive City Fabric

In planning the city of the future, the panel recognises that demand drivers are going to evolve, change, and remain undefined until years ahead. The panel recommends planning for the future city provide flexibility in its form, structure, and connection to respond to a variety of uses, their individual scale, and character and to provide a framework for flexibility over time.

In today's world, the demand for space and location of that space within a neighbourhood, community, district, or city is changing. What was a multiunit residential building is difficult to transform to office, unused carpark stations are obsolete and lie dormant, and the regional mall and its big-box department stores are fast becoming redundant. Today developers are exploring built form with built-in flexibility that can respond to change of use over time.

The panel recommends that the district framework of the city of the future provide for diverse uses that add to the depth, character, and amenities of the new city. The new city must have ingrained flexibility to allow community neighbourhoods with multiple dwelling options, shopping streets, laneways, plazas, and promenades alongside new research institutions, schools, academies and universities, large-scale office buildings, and medical facilities. Each of these, when well considered within the criteria for connectivity, accessibility, and walkability, will add to the city's diverse character rather than sit isolated as detached soulless elements of late-20th-century planning models.

The panel further recommends that in each district, development contain an element of experimentation and innovation, and through learning continually adds to tomorrow's city thinking. This may be achieved through use of autonomous transport systems, an airborne delivery system, waste management networks, or commitment to a proportion of space that is flexible, shaped for multiple uses, an incubator space for research, knowledge centre academy, and arts studio.

The Smart City of the Future: A City of Innovation

BUILDING OFF THIS URBAN DESIGN and urban policy framework, the question now becomes, *what does a city of the future mean for Wuhan?*

To compete in the future on the international stage, Wuhan will need to compete in the international war for talent, and to be able to compete at the international level, the panel recommends that the development of New Town be committed to three key principles: (1) building vibrant communities that put people first, (2) creating a city of continuous learning, and (3) developing an economic engine that will anchor New Town and attract businesses and talent.

Build People-First, Vibrant Communities

A key component to winning the war for talent is intentional, people-first development. When residents of Changjiang New Town walk out of their homes, they will be surrounded by an environment celebrating the best of Wuhan, with a vibrant and dynamic streetscape that pulls them into serendipitous interactions. The street bustles with activity from shops, restaurants, food stalls, art galleries, commercial buildings, and nearby green space. The retail shops could include green markets showcasing local delicacies or rotating “pop-ups” (or temporary uses) testing new products and constantly introducing variety to the urban environment. Wi-fi is available for residents and visitors to use outside, allowing constant connectivity. Public seating areas are abundant, creating opportunities for people to interact with their neighbours while watching children play in nearby playgrounds, or enjoying a morning tai chi class. People pass by on foot as they walk to public transportation stations or to the market. There are hiking trails and places to swim and fish at Lake Wuhu.

Vibrant Communities



The connection of the built environment to the open green space and local rivers allows the residents of Changjiang New Town to feel as if they are in the midst of a busy city while at the same time reestablishing their connection to nature.

While the quality design fundamentals are integrated throughout New Town, the implementation of those characteristics is different for each district. This will enable New Town to feel like an organic development, which breeds a sense of energy or vitality rather than sameness. For example, a portion of the streetscape could be dedicated to temporary uses to promote turnover of space to further enhance the spirit of vitality. In addition, although the community has an overarching master plan and design standards, each of the districts should reflect its own character—whether it is a university, science-oriented, or finance-oriented. This openness to change and experimentation will foster creativity. Another source of creative inspiration will be public art; museums, public galleries, outdoor sculptures, and murals can all be used to infuse a creative spirit in Changjiang New Town. In addition, the panel recommends that either a museum be relocated to Changjiang New Town or that a new museum is created for the community, to anchor a cultural district.

Vitality should also extend to health and health care. Construction should use the best in green building

Continuous Learning



An Economic Engine



WIKIMEDIA COMMONS

practices to reduce the environmental impact (low-VOC paints, sustainable materials, energy-saving appliances, and low-flow water users). Additionally, protecting the green space and cleanness of the water and the land should be emphasised. The increased walking resulting from the people-centric development will promote healthier lifestyles. The green space and environmental strategies will help the overall health of the community. In addition to these measures, a strong health care system—including a world-class hospital—will be needed, especially services that provide excellent preventive care programmes.

Affordable and flexible housing options will be a necessity to attracting and retaining talent. Housing for recent graduates of Wuhan's many universities will be one of the initial priorities, but the panel recommends that Changjiang New Town have plentiful options for people of all ages and experiences, as well as varying economic levels and family sizes. Housing for families, professionals, and workforce, along with new university graduates will be critical to establishing a diverse and vibrant community. The panel recommends Changjiang New Town be developed with a goal of creating an inclusive, mixed-use international city that will retain Wuhan's best and brightest, attract top talent from all over China, and be able to compete for global thought leaders.

Changjiang New Town will be a place where diverse people are brought together through their homes, streetscape, and open space: talking, forming connections, and sharing ideas. By developing these spontaneous interactions, people will engage one another, creating an enhanced and vibrant community.

Create a City of Continuous Learning

Building a city of continuous learning starts in childhood. The panel recommends that Changjiang New Town develop an exceptional primary education system. This starts with a world-class K–12 public education system that is available to residents who both rent and own and includes a public education system that experiments with different



Cornell Tech, located in Manhattan in New York City, is a joint venture between Cornell University and Technion–Israel Institute of Technology. It is focused on producing entrepreneurial engineers who would, in turn, start job-creating companies. This new model of graduate education incorporates collaboration with the private sector into the curriculum in a manner that allows the universities to be magnets for both talent and companies.

models for teaching and learning and uses the buildings and open space of New Town as an outdoor classroom that brings education to life for children. A K–12 science academy should also be investigated. An exceptional public education system also extends beyond the classroom. The panel recommends that Changjiang New Town include a children's science and technology discovery museum that is designed and developed to be a hands-on, experiential learning centre, making learning fun and inspiring.

Second, one of the most significant actions that the Changjiang New Town Administrative Committee can take to establish, internationally, the reputation of Changjiang New Town as a city of continuous learning, and a centre of world-class talent, is to build on Wuhan's strength as a leader in higher education and to recruit to New Town world-class institutions of higher education that will be magnets for talent and for companies competing in the war for talent.

This strategy could be implemented in several ways, and the panel has two options for the committee to consider. The first approach is to recruit two Chinese academies of

science—physics and mathematics, and survey, planning, and design—to Changjiang New Town.

The second approach is to consider a model that has been developed internationally and has been gaining significant attention, which is based on developing a new model of education that brings academia and industry together on campus. This model can be seen in operation at Cornell Tech in New York and at the Global Innovation Exchange (GIX) in Seattle.

Cornell Tech is a joint venture between Cornell University and Technion—Israel Institute for Technology, and GIX is a joint venture between the University of Washington and Tsinghua University. At both locations, the universities have developed new models of graduate education, recognizing that universities that want to attract top students and top faculty need to engage and collaborate with the private sector, and that simultaneously, more and more companies—especially tech companies—are seeking any way they can to gain a competitive edge in the war for talent and are looking to partner or collaborate with students and faculty. Both Cornell Tech and GIX represent new models of graduate education that incorporate collaboration with the private sector into the curriculum in a manner that allows the universities to be magnets for both talent and companies.

Because of the size of Changjiang New Town, both strategies could eventually be implemented, although the panel recommends proceeding with one option first.

A city of continuous learning should not stop with higher education. The city of the future is one in which continuous learning happens throughout life. To support this international trend, the panel recommends the universities that are recruited to New Town develop departments focused on both continuing education with lecture series, language classes, conferences, and performances available to the public at low or no cost, and professional training programmes with technical certification programmes to allow residents and employees of all educational backgrounds to continuously improve their economic opportunities.

Another strategy to establish New Town's reputation as a world-class city of continuous learning is to recruit members of the National Academy of Science to relocate to New Town and to develop the research facilities to support their work. One such approach is to build in New Town a particle accelerator, which could be a magnet for renowned researchers and professionals both domestically and internationally.

The panel also proposes that New Town proactively become a place that has an ethos of experimentation in which smart technologies are integrated into the landscape for continuous testing, experimentation, and citizen engagement and feedback. In this way, learning and experimentation become part of everyday life. Finally, learning should be fun and entertaining, and the panel recommends that New Town consider building a science theme park, which would be an attraction for visitors from across the country and beyond.

Develop an Economic Engine

To compete in the war for talent, Changjiang New Town must develop an economic engine that will anchor New Town, giving it a reason for being and serving as a magnet for talent and companies, both domestically and internationally. To develop this economic engine, the panel has several proposals for the committee's consideration.

First, the panel suggests the committee establish Changjiang New Town as a headquarters for financial institutions. This must begin with the recruitment of Chinese financial institutions to New Town.

Second, the panel suggests the committee consider establishing New Town as a centre for the design industry, materials science, and experimentation.

Third, the panel recommends that New Town become a “future cities laboratory”—a collection of applied research institutes specifically designed to attract private companies focused on the commercialisation of that research. These institutes are the magnets for both talent and companies.

The future cities laboratory could be launched with three institutes that leverage Wuhan's strengths:

- **Institute of Water Management and Purification:** As a city surrounded by water, Wuhan can leverage this natural resource into a sustainable industry. By bringing together the work of faculty and researchers at Wuhan universities with private sector companies focused on developing and commercializing technologies in water management and purification, Wuhan could make an institute for water an economic driver for New Town.
- **Institute of Artificial Intelligence and Manufacturing:** The panel proposes that Wuhan consider establishing an Institute of Artificial Intelligence and Manufacturing to focus on the application of artificial intelligence to manufacturing, using Wuhan's automobile, steel, and logistics industries as the starting points for research, experimentation, and commercial development in these areas.
- **Institute for Smart Cities:** The panel recommends that Changjiang New Town become a centre for the development, testing, commercialisation, and implementation of smart cities technologies. The panel recommends Changjiang New Town adopt policies that encourage and support the ability for researchers to prototype and test smart city technologies in the buildings, open space, and streetscapes of New Town such that the city acts as a living laboratory for experimentation and entrepreneurship, attracting both talent and companies to New Town for its reputation as a place for experimentation.

These institutes represent, simply, a place to start. Institutes of the future cities laboratory can grow, evolve, and

be added over time, creating a continuous and growing economic engine for New Town.

The success of these ideas will depend on New Town's ability to develop an ecosystem and ethos of entrepreneurship. New Town should be known as a place where testing, failing, and trying again are valued and supported. To develop an ecosystem to support and encourage entrepreneurship and innovation, the panel recommends that New Town focus on six key areas:

- Building a network of venture capital and angel investors;
- Recruiting experienced incubators and accelerators to support start-ups and founders;
- Providing affordable coworking space, thereby decreasing the cost and risk for entrepreneurs;
- Establishing a department for business development support to help entrepreneurs navigate bureaucratic institutions, connect with mentors and investors, and build a network and community;
- Implementing transparent and stable policies to attract international investors and companies; and
- Hosting international competitions to promote the development, testing, and implementation in New Town of new products and technologies.

Using this approach, New Town will be able to create a sustainable ecosystem to enable it to become a city of innovation and entrepreneurship.

The Smart City of the Future: Finance and Governance

THE PANEL HAS SEVERAL RECOMMENDATIONS on how New Town should be governed and how it could provide a test bed for a new revenue regime. Although still part of the city of Wuhan, New Town could operate as a separate entity, eliminating the bureaucratic excesses that are typically part of large city governments. To achieve the goals outlined in this document, New Town will have to operate with some level of independence from the city.

Governance

The city of Wuhan has already correctly organised the development of New Town under a separate administration, Changjiang City Administrative Committee, that can plan, review, and permit development in the district. The innovative management structure of separating economic development and social management enables the Changjiang City Administrative Committee to focus on development with its limited manpower resources. Such an approach will not only allow the city staff to focus on the achieving the New Town vision, it will also allow it to be much nimbler in addressing the innovative design issues during development and maintenance issues throughout the life of the district.

Taxation Regime

Wuhan may enhance its taxation regime by imposing a property tax on residential properties. The recurring tax would help fund the government's activities in a sustainable way. Approaches to obtaining reoccurring revenue could include the following:

- A property tax, millage tax is an ad valorem tax that an owner of real estate or other property pays on the value of the property being taxed. There are three types of property: land, improvements to land (immovable

man-made things), and personal (movable man-made things). *Real estate*, *real property*, or *realty* are all terms for the combination of land and improvements. The taxing authority requires or performs an appraisal of the monetary value of the property, and tax is assessed in proportion to that value. Forms of property tax used vary among countries and jurisdictions.

- A services levy is imposed on property to provide specific services, such as fire and rescue, police services, road maintenance, or social services. This could include a business improvement district-like levy to provide basic services, such as cleaning streets, providing security, making capital improvements, constructing pedestrian and streetscape enhancements, and marketing the area.

These recurring revenue streams could be monetised using methods such as tax increment financing, providing a fund to undertake infrastructure projects that achieve New Town's goals.

Other Funding Approaches

The panel also suggests other potential creative financing approaches that may be considered as a part of the Changjiang New Town. Some of these will require implementing a new tax regime; others can operate under the present management structure. They include the following:

- Housing fund;
- Venture capital fund committed to New Town;
- New talent fund;
- Public/private partnership;
- Tax credit programmes; and
- Municipal loan programmes.

Conclusion

CHANGJIANG NEW TOWN OFFERS the city of Wuhan a tremendous opportunity to build a city in a manner that future-proofs it against the competing risks: ecological degradation, loss of the ability to attract and retain talent, the impact of global climate change, new modes of transportation, new patterns in workspace, and new approaches to energy consumption and generation. All of these challenges need to be considered as the New Town framework is prepared. This report outlines some basic approaches to transportation, housing, energy and water, waste disposal, and economic drivers that can be considered in this framework preparation. The ULI panel's vision for New Town is one that enables it to feel like an organic development, which breeds a sense of vitality rather than sameness. It is also one that establishes early in the planning process a focus on putting people first. To accomplish this goal, natural systems such as rivers and streams,

vegetation, and open space need to be considered as an integral part of the initial planning process. The design of nodes, neighbourhoods, and gathering areas needs to be foremost in the mind of the decision makers who will make this town a reality.

Much work must be done in preparing the plan for Changjiang New Town. The panel believes this location can distinguish itself from other locations in Wuhan and the rest of China. The panel knows all too well the Chinese ability to plan and build and build quickly. The question is whether Wuhan can build correctly or whether it will just build the same. The city is at a crossroads where it can influence and create a whole new paradigm for how new city development is achieved.

About the Panel

Tom Murphy

Panel Chair

Pittsburgh, Pennsylvania/Washington, D.C., USA

Murphy is a senior resident fellow at the Urban Land Institute and the Canizaro/Klingbeil Families Chair for Urban Development. A former mayor of Pittsburgh, Murphy has extensive experience in urban revitalisation—what drives investment and what ensures long-lasting commitment.

Before his appointment as senior resident fellow, Murphy served as ULI's Gulf Coast liaison, helping coordinate with the leadership of New Orleans and the public to advance implementation of rebuilding recommendations made by ULI's Advisory Services panel after Hurricane Katrina. In addition, he worked with the Louisiana leadership, as well as with leadership in hurricane-affected areas in Mississippi, Alabama, and Florida, to identify areas appropriate for ULI involvement.

During his three terms as mayor of Pittsburgh, from January 1994 through December 2005, Murphy initiated a public/private partnership strategy that leveraged more than \$4.5 billion in economic development in the city. Murphy led efforts to secure and oversee \$1 billion in funding for the development of two professional sports facilities and a new convention centre that is the largest certified green building in the United States. He developed strategic partnerships to transform more than 1,000 acres of blighted, abandoned industrial properties for new commercial, residential, retail, and public uses, and he oversaw the development of more than 25 miles of new riverfront trails and urban green space.

From 1979 through 1993, Murphy served eight terms in the Pennsylvania House of Representatives. He served in the Peace Corps in Paraguay from 1970 through 1972. He

is a 1993 graduate of the New Mayors Program offered by Harvard University's Kennedy School of Government. He holds an MS in urban studies from Hunter College and a BS in biology and chemistry from John Carroll University.

Allen K. Folks

Sacramento, California, USA

Folks is a registered landscape architect and urban designer with experience in urban revitalisation and community planning assignments. In 32 years of practice, he has been responsible for a variety of assignments, including the preparation of plans for new towns and existing communities, transit-oriented development areas, reuse of military bases, design of corporate and civic campuses, and public open-space planning. Folks usually directs teams of engineers, environmental scientists, and economists to solve urban problems that have a creative vision and are economically feasible.

Before joining Ascent, a multidisciplinary practice headquartered in Sacramento, in 2016, Folks spent over 28 years working at EDAW and AECOM in the San Francisco, Sacramento, and Singapore offices. From 2012 to 2015, he led the AECOM SE Asia Business Line for Buildings and Places, with management responsibility for over 110 staff in Singapore, Jakarta, Kuala Lumpur, and Manila.

Folks has been involved with the revitalisation of urban environments in many U.S. cities and within Southeast Asia. In many of those assignments, the focus was on developing a meaningful and impactful public realm as the organizing armature for private sector investment. He has led community visioning exercises for public sector agencies and developer-led consortiums. He has lectured in the United States and Asia on the benefits of transit-oriented

development and liveable cities and is a guest lecturer at the University of California at Davis.

He is a member of the American Planning Association, the American Society of Landscape Architects, and the Urban Land Institute, of which he has served as the district council chair for Sacramento and has been a member on several national product councils, including most recently the Transit Oriented Development Council. Folks has participated in 12 ULI Advisory Services panels to assist in solving downtown and neighbourhood redevelopment issues. He is a graduate of Temple University and the University of Pennsylvania.

Kate Bicknell

New York, New York, USA

Bicknell leads Forest City's partnership with Cornell Tech, including the development of the Bridge at Cornell Tech, where industry and academia will have the opportunity to work side-by-side to spur innovation and the commercialisation of new products and technologies. In addition, she leads Forest City's efforts with Johns Hopkins to build partnerships with and attract biotech and life sciences companies to the East Baltimore Science + Technology Park, adjacent to the Johns Hopkins Medical campus.

She spent her first eight years at Forest City in a leadership role in the development of Pacific Park Brooklyn, a \$4.9 billion, 22-acre public/private partnership, anchored by Barclays Center. Before joining Forest City, Bicknell worked as a legislative aide to the late Senator Daniel Patrick Moynihan and was the federal policy director for Smart Growth America.

Bicknell holds an MBA from the Wharton School and a BS in urban studies from Cornell University's College of Architecture, Art and Planning, where she currently serves as cochair of the Dean's Advisory Council. In 2017, she was selected by the Partnership for New York City to be a Rockefeller Fellow.

Paul Doherty

Memphis, Tennessee, USA

Doherty is president and CEO of TDG (the digit group) and is one of the global industry's most sought-after thought leaders, strategists, and integrators of process, technology, and business. A senior fellow of the Design Futures Council, Doherty is an award-winning architect, author, educator, analyst, and adviser to Fortune 500 organisations, global government agencies, prominent institutions, and the most prestigious architectural, engineering, and contracting firms in the world.

A pioneer in building information modelling (BIM) and a former Fortune 500 corporate officer, Doherty is a prominent and highly rated speaker at numerous industry events around the world each year and has been appointed as a guest lecturer at leading universities throughout the world. His past successful ventures include Revit Technologies (sold to Autodesk 2002), Buzzsaw (sold to Autodesk 2001), and TRIRIGA (sold to IBM 2011).

His current work is focused on smart city real estate developments that include financing, executive project management office and delivery, central BIM office services, and implementing innovative technology solutions within TDG projects around the world. TDG's smart cities real estate development projects are operating in Japan, China, New Zealand, Australia, Malaysia, India, Kingdom of Saudi Arabia, United Arab Emirates, Ireland, and the United States. Concurrently, Doherty is the cofounder and producer of the critically acclaimed and popular AEC Hackathon (www.aechackathon.com) that launched at Facebook Headquarters in Silicon Valley.

Billy Grayson

Washington, D.C., USA

Grayson is the executive director for the Center for Sustainability and Economic Performance at the Urban Land Institute, a nonprofit education and research organisation that focuses on land use, real estate, and urban develop-

ment. The mission of the Institute is to provide leadership in the responsible use of land and in creating and sustaining thriving communities worldwide.

As executive director, Grayson manages a team leading programmes on climate risk and resilience, health and wellness, and building energy and environmental performance. ULI works with members, community leaders, coalition partners, and other key stakeholders to build awareness around sustainability issues in the built environment and to provide its members with the tools and resources they need to cost-effectively drive sustainability into their projects and operations.

Grayson has over a decade of experience leading energy and sustainability initiatives in real estate, distribution, and supply chain operations. As sustainability director at Liberty Property Trust, he led a 700-building initiative that included green building construction, energy efficiency retrofits, and sustainability-focused property management strategies and tenant engagement. As vice president, social and environmental sustainability, for the Electronics Industry Citizenship Coalition, Grayson led a global compliance programme working with electronics manufacturers in China, Malaysia, Korea, and around the world to identify and mitigate environmental and human rights risks in their shared supply chain, as well as programmes addressing climate change mitigation. As sustainability director at THE PANEL SCO, Grayson developed an operational sustainability programme that reduced energy, water, and waste more than 15 per cent and launched a global marketing initiative for THE PANEL SCO's sustainability-focused energy technology products and services.

He holds an MBA and a master's of public policy from the University of Maryland and a bachelor's in environment, economics, and politics from Claremont McKenna College. He is a LEED AP and former board member of the Delaware Green Building Council and NAREIT Sustainability Advisory Committee.

In-Keun Lee

Seoul, South Korea

Graduating from Seoul National University with a BSc in 1979, Lee started at the civil service in Seoul. Through 32 years of service with the Seoul Metropolitan Government, where he rose to the position of assistant mayor, he was involved in managing various departments dealing with urban planning as well as landmark projects in the Korean capital. His responsibilities included the planning and development of highways, subways, waterworks, and later the prestigious Cheong Gye Cheon Restoration project.

As a senior civil servant, Lee formulated strategic urban policy and plans, guiding the capital to become a more sustainable, people-oriented, and public-transit-served city. He played an important role in transforming Seoul into a world-class city.

In September 2013, Lee joined the Korea Land and Housing Corporation (LH) as the head of its Research Institute. LH is the largest public corporation in Korea specializing in land development and affordable housing. His research extended over planned (new) towns, housing welfare, smart city, and green building technologies. Completing a three-year term with LH, he was made a visiting professor of his alma mater, Seoul National University.

He has been a commissioner of the Presidential Commission on Architecture Policy since February 2016. The commission deliberates or coordinates major policies on the built environment in the Korean government.

In 1985 he won a government fellowship for overseas study and carried out engineering research at City, University of London, which awarded him a PhD in 1991. He is a fellow of the Institution of Civil Engineers, UK, and a senior member of the National Academy of Engineering of Korea.

David McCracken

Sydney, Australia

McCracken is the principal of Voda Management, a collaborative advisory network across the property industry working with developers, landowners, consultants, and government on strategies to achieve maximum benefit through urban and community outcomes, design and development leadership, and place creation.

An architect by training, McCracken has been working across all parts of property development for almost 20 years. He has held leadership roles at major Australian and international corporations working in Australia, Asia, Europe, the United Kingdom, and North America. Having worked at both project director and general manager levels, McCracken brings both the aspirational and commercial sides of a project together, combining strategic planning with design and development leadership.

McCracken is the executive director of the Urban Land Institute as well as holding several advisory positions with government and industry. He is also the chair of KU Children's Services.

Sara B. Queen

New York, New York, USA

Queen spent nearly 11 years running asset management for Brookfield Property Partners' U.S. Office Platform, which comprised more than 60 buildings encompassing 45 million leasable square feet in New York City, Boston, Washington, D.C. (including suburban Maryland and Virginia), Houston, Denver, Los Angeles, Seattle, and San Francisco. She was the chief company representative and liaison with coinvestors in Brookfield's U.S. Office Fund, Downtown Los Angeles Fund, DC Core Fund, as well as other joint venture partnerships. She was also responsible for the company's occupancy profile and its annual strategic planning and budgeting activities. She oversaw Brookfield's Lease Administration, its award-winning Arts and Events group, and Marketing departments, in addition

to serving on the Global Asset Management Committee and the Executive Committee for the U.S. Office Division.

Before joining Brookfield, Queen was senior vice president at Clarion Partners, the New York City-based real estate management and advisory services firm, in charge of managing a \$1.9 billion portfolio of commercial properties. Previously, she worked for Metropolitan Life Insurance and spent five years with the company in roles of increasing responsibility in the investment and asset management groups.

Queen has an MBA from the Harvard Business School and a BA in economics and history from Wellesley College. She is being honored this year as the WX (New York Women Executives in Real Estate) Woman of the Year and was named to the prestigious 40 under 40 list by *Crain's NY Business* (2008). In addition, she was selected as a Woman of Distinction by the Girl Scout Council of Greater NY (2008) and a Woman of Influence by Real Estate Forum in 2009, 2014, and 2015. She is a member of the board of directors for Trinity Church Wall Street (where she oversees Trinity's \$5 billion joint venture with Norges Bank and Hines), Friends of Governors Island, the WX Charitable Board, and Solar One.

Queen is an adjunct professor at Columbia University's Master of Real Estate Development Program, teaching commercial leasing and asset management.

Chin Beng Yap

Singapore

Yap is senior adviser, estate and corporate, of the Singapore Housing and Development Board (HDB), the public housing authority of Singapore providing housing for over 80 per cent of the resident population. HDB develops and manages more than 1 million dwelling units in 26 towns/estates, as well as a full range of commercial and social communal facilities. In this capacity, Yap works closely with HDB's senior management in a key advisory role in housing policy development and review, planning of the

building programme, estate rejuvenation and redevelopment, and Town Council matters. He also advises on HDB information and communication technology (ICT) strategies and drives the organisation's knowledge management initiatives, as well as contributes his expertise towards HDB's digital transformation journey.

Before assuming his current appointment in July 2017, Yap was the deputy chief executive officer, estate and corporate, of HDB, overseeing a wide spectrum of functions, including the formulation of public housing policies and special housing programmes; supply of new housing units; planning and management of HDB car parks, and industrial and commercial properties; and implementation of programmes to promote community bonding. He implemented several innovative housing schemes, such as the Selective En Bloc Redevelopment Scheme and Lease Buyback Scheme, and developed a long-term housing demand model.

More recently, he led the development of an award-winning vertical village project, the Kampung Admiralty, which integrates senior housing with a medical centre, active aging hub, food centre, supermarket, sky garden, community farm, and community plaza. He also oversaw corporate communications, formulation of corporate strategies, and provision of ICT, legal, audit, and financial services to support HDB's operations.

Outside of his main portfolio, Yap also shares his expertise as a member of the Centre for Liveable Cities Expert Panel, as well as delivers talks and lectures on public housing for advanced courses organised by the Centre for Liveable Cities, Civil Service College, Lee Kuan Yew School of Public Policy, National University of Singapore, and Ministry of Foreign Affairs. Yap was on the board of EM Services from November 2008 to June 2017, and the Council of Estate Agencies from October 2010 to July 2017. He is currently co-chairman of the Public Housing Subcommittee in the Sino-Singapore Tianjin Eco-city.

A Colombo Plan Scholar, Yap joined HDB in 1979 after graduating with an honours degree in surveying from the University of New South Wales. He was awarded the HDB Postgraduate Scholarship and obtained a master of business administration (with distinction) from the University of Warwick, UK, in 1994. For his outstanding contributions to public service, Yap was conferred the National Day Awards—Public Administration Medal (Silver) in 2006 and the Public Administration Medal (Silver)(Bar) in 2016.

About ULI Project Staff

Thomas Eitler

Washington, D.C.

As a senior vice president for the Urban Land Institute, Eitler manages the professional team that makes possible the Institute's advisory panels that provide strategic advice to communities and organisations on a wide variety of real estate, planning, and urban design, and public policy subjects. In addition, he was the principal author of ULI's *Ten Principles for Building Healthy Places*.

An urban planner and land use professional with more than 25 years of experience in comprehensive planning, revitalisation, historical preservation, transportation systems, economic development, and sustainable design, Eitler is an expert on U.S. zoning law, municipal codes, and urban design and government operations. He has prepared and conducted hundreds of reports on community engagement plans, charrettes, advisory groups, workshops, and panels. Eitler has authored numerous plans, studies, strategies, and reports on urban planning, design, land economics, public administration, and real estate development. He has directed projects in both the public and private sectors in a variety of locations throughout the United States, Europe, the Middle East, Africa, and Asia.

Before joining ULI, Eitler was a principal with Community Planning Associates LLC, a land planning consulting firm based in Washington, D.C. Before that he was director of operations for the Onyx Group, a planning and architectural firm with offices in Virginia, California, and Hawaii. Earlier, he was a principal planner with a number of local governments, including chief of the long-range planning for Prince William County, Virginia, where he established the county's first urban growth boundary initiative, Traditional Neighborhood Design ordinance, and financial guidance for its impact fee system.

He has a master's degree in urban and environmental planning from the University of Virginia's School of Architecture and three undergraduate degrees in urban studies, political science, and public administration. Eitler is a member of the American Institute of Certified Planners, the land economics society Lambda Alpha International, and the Dean's Advisory Board at the University of Virginia's School of Architecture.

Ken Rhee

Shanghai, China

Rhee is the chief executive officer of Huhan Business Advisory, a firm that primarily advises real estate developers and investment funds on investment opportunities at home and abroad. He also serves as the chief representative of ULI in mainland China.

Before establishing Huhan Business Advisory, Rhee worked for Morgan Stanley between 2006 and 2011, initially as vice president and later as executive director. At Morgan Stanley, he played key roles in assignments such as successfully raising capital for the initial public offering (IPO) and subsequent bonding offering by Shimao Property and for Shanghai Real Estate's bond offering. He also played key roles in a series of investments that included pre-IPO investments in leading developers and hard asset acquisitions. Rhee's previous work experiences include heading up the investment operation at Shanghai Dragon Investment—an investment arm of the Shanghai municipal government—and doing mergers and acquisitions advisory work at JP Morgan based in Hong Kong and Singapore between 1998 and 2002. In the early and mid-1990s Rhee worked for the Federal Deposit Insurance Corporation as a bank examiner based in Los Angeles, California.

Since 2012, Rhee has led the growth of ULI in mainland China. As of September 2015, ULI had over 450 members, including leading developers, investors, architects, and other real estate professionals in mainland China. Rhee has written the ULI mainland China city survey report and a case study; participated on ULI Advisory Services panels in Sanya and Foshan; and served as the project director of the report *Ten Principles for Urban Regeneration: Making Shanghai a Better City*.

Rhee graduated from the University of California, Los Angeles, with a BA in economics and business in 1991 and from the University of Chicago's Booth School of Business with an MBA in 1998.

May Chow

Hong Kong SAR

Chow's career spans journalism, media, corporate communications, and marketing. The breadth and depth of her experience makes her a strategic marketing leader and an engaging business partner who constantly drives growth and development.

She joined the Urban Land Institute in August 2016 as senior vice president of marketing and communications for Asia Pacific. Partnering with the global, regional, and local teams, she drives branding and marketing initiatives in Asia Pacific and delivers programmes to enhance member and leadership engagement that advance ULI's mission in providing leadership in the responsible use of land and in creating and sustaining thriving communities worldwide.

Before her role at ULI, Chow was senior director and head of marketing and communications at a global real estate consultancy firm. She also held management positions in other industries including media, communications and information technology.

Having lived in Asia, the United Kingdom, Europe, and the United States, Chow thrives in a multicultural environment. She embraces people and cultures, with passion to build teams for success.

Abel Xu

Shanghai, China

Xu has more than ten years of work experience in the real estate industry in mainland China. He joined Huhan in February 2012 and is currently responsible for market research and financial analysis of real estate investment opportunities.

Before Huhan, Xu worked at China Real Estate Information Corporation. In that role, he was mainly in charge of strategic and financial analysis of property developers, with a focus on mainland Chinese property developers listed on the Hong Kong Stock Exchange.

Xu serves as cochair of the organizing committee of the Urban Land Institute's Young Leaders Group in Shanghai. Together with other committee members, he organises educational and interactive activities for real estate professionals under 35 years old in the city.

He earned his bachelor's degree in economics from East China University of Science and Technology. He speaks fluent Mandarin and English.

A ULI Advisory Services Panel Report



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Suite 200
Washington, DC 20036

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