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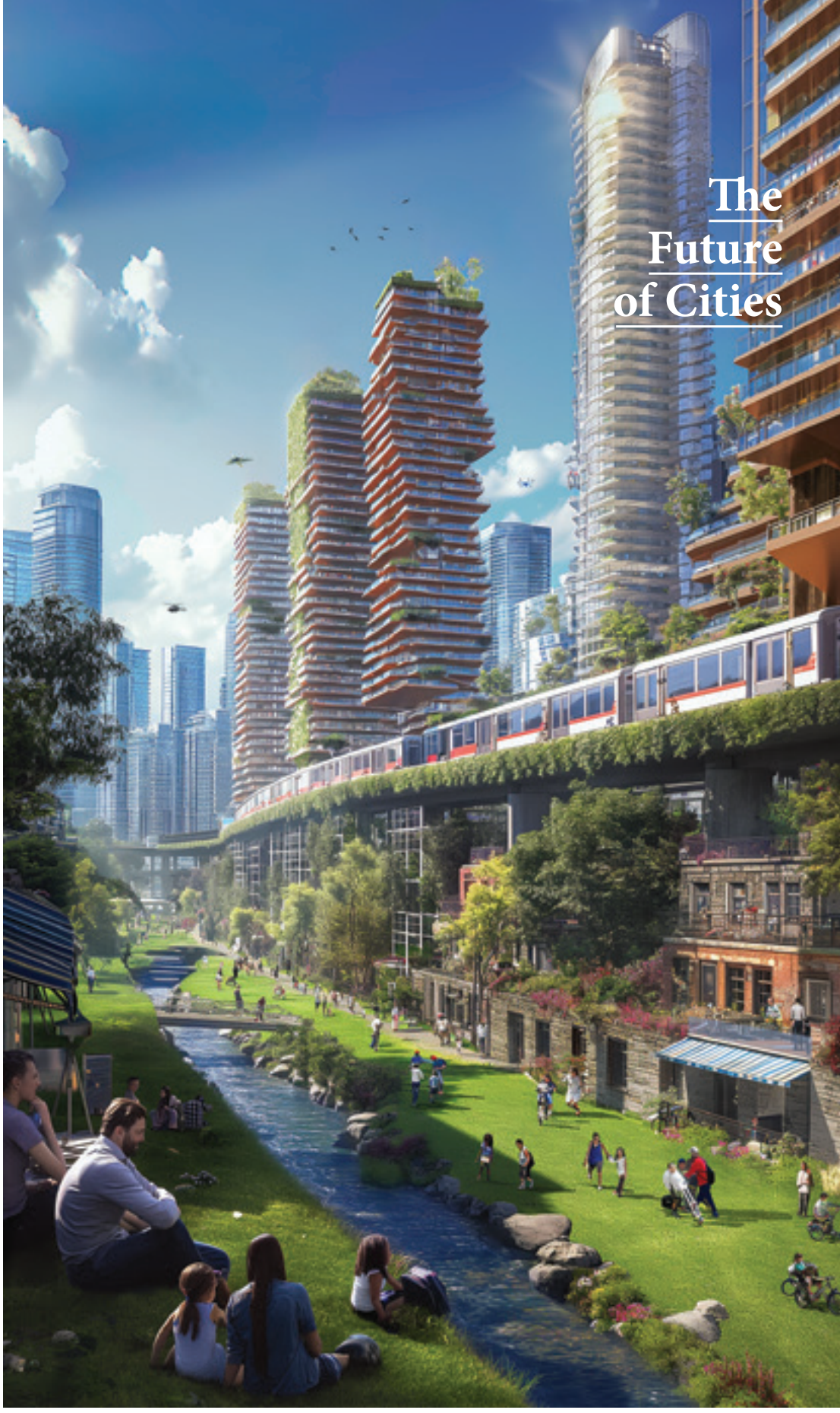
URBAN SOLUTIONS



The Future of Cities

A biannual magazine published by CENTRE for LiveableCities SINGAPORE

URBAN SOLUTIONS

ISSUE 24 • JUN 2024

CENTRE for LiveableCities SINGAPORE

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URBAN SOLUTIONS is a bi-annual magazine published by the Centre for Liveable Cities. It aims to equip and inspire city leaders and allied professionals to make cities more liveable and sustainable.

Set up in 2008 by the Ministry of National Development and the then-Ministry of the Environment and Water Resources, the Centre for Liveable Cities (CLC)'s mission is to distil, create and share knowledge on liveable and sustainable cities. CLC's work spans four main areas—Research, Capability Development, Knowledge Platforms, and Advisory. Through these activities, CLC hopes to provide urban leaders and practitioners with the knowledge and support needed to make our cities better. For more information, visit www.clc.gov.sg.

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Cover Image: Illustration of a liveable, sustainable, and inclusive city of the future.
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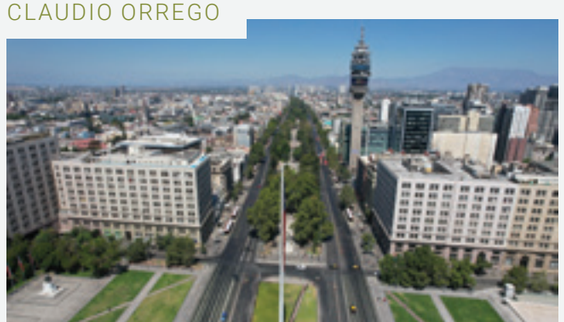

“The transformation of CBDs into Cultural Business Districts reflects a paradigm shift in urban development. It's about creating vibrant, inclusive spaces where economic vitality intertwines with cultural richness.” 26

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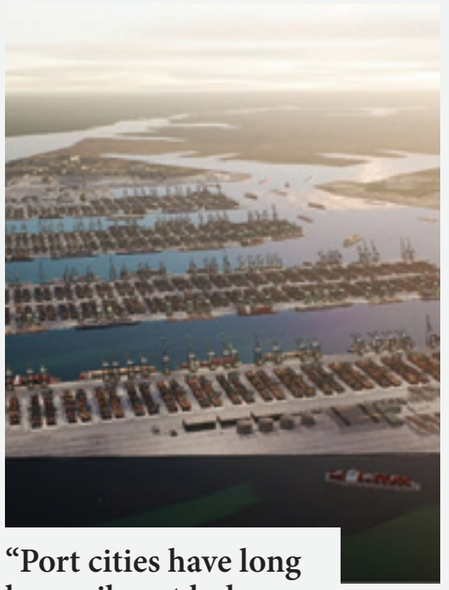

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CARLO RATTI

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From the Executive Director

Taking Cities into the Future

As we design for the future of our cities, we have the opportunity to rejuvenate, reinvent and reimagine our well-worn urban planning paradigms.

For one, the growth of cities must be in harmony with nature, if we are to tackle climate change and for our cities to remain liveable.

Climate change will impact vulnerable groups disproportionately, thus exacerbating economic inequalities, to the detriment of social cohesion. In an interview for this edition of Urban Solutions, Claudio Orrego, Governor of Santiago, draws attention to how the poorest communities are most at risk of extreme heat stress, and emphasises that the benefits of smart city projects must be equitably shared.

Bambang Susantono details the approaches adopted by the Nusantara Capital Authority, in planning for Indonesia's new capital. By embracing nature-based solutions, his team hopes that Nusantara will coexist with Mother Nature, while offering residents a pleasant living environment.

Secondly, the future of our cities lies in collaborative partnerships and data-driven transformations.

In the downtowns of Chicago and Los Angeles, Kenya Merritt and Richard Green sketch a future of urban planning that is consultative and achieves a high degree of citizen engagement.

Across the Atlantic, the Helsinki Energy Challenge brought together the brightest minds from around the globe, to design future-ready heating solutions. Carlo Ratti shares his experience designing Helsinki's Hot Heart—a floating thermal basin that generates enough renewable energy to keep visitors warm and provide surplus energy to the City of Helsinki's electricity grid.

Underpinning these extensive public consultations and crowdsourcing of ideas is technology. Yang Jung-Won shares how the data collected from pilot tests at the Busan Eco Delta Smart Village helped assess the viability of scaling up new technologies to other parts of the country.

Finally, cities can temper the potential disruptions of rapid technological advancement by being people-centred and retaining a sense of heritage.

Marcos Neto reminds us that technology is merely a means to improve human lives. Neto shares how the UNDP developed the Con Vos initiative in Argentina and helped to foster digital inclusion.

As Barcelona rapidly modernises its BlueTech Port, Javier Salsas recounts how it helps residents maintain an intimate sense of place and connection, by reaffirming the area's rich maritime heritage.

The future can at times seem unpredictable and even intimidating, but it is my hope that this edition of Urban Solutions will stir your imagination and offer ideas as to how we can best harness the potential of technology, while mitigating against unintended consequences.

Reimagining a better future is both an act of faith and a commitment to seeing that the best days of our cities still lie ahead.

Hugh Lim

Executive Director
Centre for Liveable Cities

IN CONVERSATION WITH
CLAUDIO ORREGO

Towards a More Inclusive and Sustainable Future for Santiago

Claudio Orrego, Governor of Santiago Metropolitan Region, tells us about the exciting transformation that the megalopolis is undergoing to be a city of the future.

Image: Government of Santiago

> As a regional government, we meet challenges with modern and open management. Our style of government advocates citizen participation, presence on the ground, intersectoral action, public-private partnership, and transparency.

As cities continue to evolve, transform and grow in the face of climate change, ageing population and infrastructure, what are the biggest challenges facing Santiago and how is the city overcoming these challenges to advance the vision for a more sustainable and resilient city of the future?

Santiago is a megalopolis almost twice the size of cities like Madrid and Barcelona. More than 8 million living in our city's 52 municipalities make up about 42% of the national population. Santiago's size and population density pose an enormous challenge to leadership and governance.

In addition, there are huge socio-economic disparities between the centre and the peripheries of Santiago. These differences have grown as a result of the Social Outbreak of 2019 (a series of protests known in Chile as the *Estallido Social*) and the COVID-19 pandemic.

Currently, about 8% of the population is below the national poverty line and we have seen a substantial increase in crime rates. While only about 8% of the population now comprises migrants, this proportion has increased exponentially in the last five years. Moreover, our indigenous population accounts for about 5% of our Santiago population.

Avenida Libertador General Bernardo O'Higgins, mostly known as La Alameda or Alameda del Libertador Bernardo O'Higgins, is the main avenue of the city of Santiago, the capital of Chile.
Image: Government of Santiago

On top of that, the housing challenge that Santiago faces includes both a housing shortage and the need to improve the quality of its neighbourhoods. There are 35 communes with a concentration of 10% of Santiago's housing deficit. Recent studies detail that at the national level there is a housing deficit for 588,632 households, which represents 9% of the total number of households in the country. Furthermore, 44% of the deficit is located in the metropolitan region.

In addition, we have significant temperature differences between the various communes of the city. Territories with the most vulnerable population usually suffer temperatures up to 5 degrees higher than the territories with the highest incomes.

At the same time, our Mediterranean region has been greatly affected by climate change, with drought, extreme heat and forest fires being some of the main risks. In 2022, we had a 72% rainfall deficit that nearly led to mass water-rationing. Furthermore, in Santiago, we have to manage natural disasters ranging from earthquakes to floods and landslides.

As a regional government, we meet these challenges with modern and open management. Our style of government advocates citizen participation, presence on the ground, intersectoral action, public-private partnership and transparency.

Nueva Alameda Providencia is the most important urban transformation project in our region, covering eight km of public space and benefiting the thousands of people who use the avenue.

Our government set up a Department of Environment, Climate Action and Biodiversity–the first such department established in Chile's subnational governments. This department, together with the regional council (parliament of the region), has designed and implemented numerous policies and projects:

- Emergency Declaration and Climate Action Plan
- Cleaning of illegal landfills
- Water Emergency Board
- Agreement with water sanitation services of rural communities
- Regional Recycling Plan
- Biodiversity Conservation Plan
- Responsible pet ownership programmes
- Regional Forestry Programme

Santiago de Chile is known for its extensive smart city projects, and you won the Leadership award for the World Smart City Award 2023 recently. Please share your experience in advancing smart city projects in Santiago.

Our regional government is investing in numerous projects with a smart city focus, mainly to renew the centre of the capital, strengthen the multi-sector and multi-level governance of the region and improve safety and security. A key project, which won us the leadership award at the Smart City Expo World Congress in Barcelona 2023, is *Nueva Alameda Providencia*.

It stands as the foremost urban transformation project in our region, spanning eight km of public space. The project is supported by the Metropolitan Regional Government of Santiago, in collaboration with various institutions of the central government of Chile, as well as the municipalities of Providencia, Santiago, Estación Central and Lo Prado. In addition, it has significant support from the business sector, civil society organisations and universities.

Along the Alameda flows the Mapocho, the main river of the capital. It rises in the El Plomo hill in the Andes mountain range and flows into the Maipo river.
Image: Government of Santiago

The Alameda is home to some of the city's main buildings. The Palacio de La Moneda (Government House), located on the north side of the Alameda, is undoubtedly the main architectural landmark of the avenue.
Image: Government of Santiago

The large Nueva Alameda Providencia project is made up of five parts:

1. Recovery and maintenance of facades and public space, with a special emphasis on heritage properties—the cleaning and maintenance of facades and sidewalks project continue over the next three years.

2. Renovation of Plaza Italia—nicknamed the "Heart of Santiago", the square is one of the most common meeting and transit points in the entire capital, and when completed, will see the convergence of three parks around it to facilitate better passenger flow from the different transportation modes and pedestrian traffic. Work will begin in June 2024.

3. Construction of a Metropolitan Bikeway—a high-quality cycle path (that promises to be the longest in the capital and the country) will connect with 13 existing cycle paths and five planned paths, thus consolidating a 42-km cycling network. Construction of the project will begin in May 2024.

4. Renovation of the urban zone of Avenidas Pajaritos and Parque Santiago Bueras—this urban area where several of the main avenues of the city intersect, currently has illegal landfills and a design that does not meet the city's standards for mobility and urban aesthetics. The redesign of the Pajaritos road junction and Santiago Bueras Park will see the addition of new paths, trees and lights. Along with this, the development of an underground vehicular crossing is being considered to allow better flow of cars and people.

5. Conservation and improvement of the public space of Avenida Alameda—different initiatives led by the Santiago government aim to recover sidewalk space, add lights, surveillance cameras, bus stops, trees, roads and street furniture. This project is underway and includes approximately 140,000 m^2 of public space. The improvement works are estimated to benefit the nearly two million people who pass through the Alameda every day.

6. Another key project that seeks to improve the governance of our complex region is the Santiago Regional Integrated Management Centre. The centre harnesses technology to facilitate inter-institutional agreements to establish integrated procedures and protocols using geospatial information for better management of the region. This is expected to help us to quickly identify issues and problems for more efficient decision-making and follow-up action.

The centre has the following components:

- Metropolitan Data
- Integrated remote surveillance system
- Citizen Vision Consultation Channel
- Information Cores
- Work commute accidents
- Camera viewsheds
- Urban GINI, a metric used to evaluate inequality in the distribution of income and understand dynamics of inequality in urban areas
- CAPCA or *'Capacidad de Carga'* (Load Capacity Monitor)—a software developed to analyse the relationship between demand and capacity for existing services within a given territory.

The installation project began on 17 October 2021 and has a budget of 3.3 billion pesos (US$ 3.5 million) approved by the Regional Council.

Located just steps from the civic center of Santiago, Cerro Santa Lucía is a historical and cultural icon of the city and the Metropolitan Region.
Image: Government of Santiago

San José Volcano and Cerro Catedral located in the commune of San José de Maipo in the Metropolitan Region of Chile.
Image: Government of Santiago

How do you ensure that the benefits of smart city projects are accessible to all citizens, including the socially vulnerable and marginalised communities?

> We work for the 52 communes that compose the region, but with special attention to the most vulnerable territories, taking into account their socioeconomic and environmental variables.

Firstly, our governance style is to promote citizen participation, presence on the ground, intersectoral action, public-private partnership and transparency. This style has allowed us to collectively define the priorities of the population in the various territories, as well as to design and implement efficient and effective solutions. Secondly, we focus resources on the most vulnerable territories, taking into account their socioeconomic and environmental variables.

For example, we are working on the improvement and expansion of two island hills, Cerro Chena and Cerro Renca, with socially vulnerable communities. We have begun the construction of the Ortuzano Intercommunal Park on land that until recently was an illegal dump.

In peripheral areas with low tree density that experience extreme temperatures, especially in summer, we are planting more than 30,000 trees. In addition, we are building plazas and pocket forests on unused sites. We are also implementing sustainable solutions for water provision, especially in vulnerable rural communities. Such solutions range from the creation of local water security strategies, improvement of drinking water systems to aid for municipalities and citizens to implement smart irrigation.

In the area of social development, we are implementing various initiatives in developing territories to promote economic autonomy for women and young people through courses on topics in high demand by employers, such as computer programming.

How has the city leadership in Santiago leveraged on strategic partnerships with various sectors, e.g., public, private and people sector, to develop innovative solutions to meet complex urban challenges?

All our projects have been designed and implemented through a complex network of alliances between the various levels and sectors of the state administration (ministries, vice-ministries, autonomous agencies, public security and law-enforcement institutions, and municipalities), civil society organisations, universities, companies and business unions. These alliances have been forged with very high standards of probity and transparency, through dialogue and consultation.

At the same time, we have established close ties with the various arms of international organisations like the United Nations (UN), and with international networks and philanthropic organisations, such as C40—

Aerial view of the Civic Quarter of Santiago. The buildings it houses are, for the most part, government offices and buildings, both ministries and other public agencies.
Image: Government of Santiago

INTERVIEW

Our intensive efforts to promote dialogue with stakeholders and our broad scope of improvement works will contribute to making Santiago safer, more inclusive and sustainable for all. We will recover the city for the people.

a global network of nearly 100 mayors of leading cities to confront the climate crisis, Vital Strategies—a global public health organisation, Bloomberg, and the Rockefeller Foundation.

In summary, our leadership and governance aims to improve the well-being of the people of our region through the forging of wide-ranging alliances and collaboration. Our intensive efforts to promote dialogue with stakeholders and our extensive scope of improvement works will help Santiago be safer, more inclusive and sustainable.

FINLAND

From Cold to Warm: Helsinki's Hot Heart and the Global Climate Innovation Challenge

TEXT: CARLO RATTI

Developed as part of the Helsinki Energy Challenge organised by the municipality of Helsinki to accelerate the city's transition towards carbon-neutrality in heating by 2030, Hot Heart highlights the vision of a cleaner and greener future.

Carlo Ratti is a professor at MIT where he directs the Senseable City Lab, and at Milan Polytechnic where he is founding partner of the design and innovation office CRA-Carlo Ratti Associati. He is also the curator of the Venice Architecture Biennale 2025.

Hot Heart
Image: CRA-Carlo Ratti Associati graphic team—Gary di Silvio, Pasquale Milieri, Gianluca Zimbardi

The Hot Heart project is highly adaptable and could be replicated by other cities with similar climatic characteristics.

It is a mistaken belief that with climate change, rising temperatures will only have negative consequences for the already hot regions while creating pleasantly milder environmental conditions in the countries closest to the poles. It is an illusory notion because it forgets a fundamental question: who would benefit from a more temperate climate if it is accompanied by extreme events and rising sea levels?

Conscious of this, cities in northern Europe have been fanning the winds of change towards sustainability. According to the World Economic Forum, nine out of 10 of the leading countries in sustainability transition are on the Old Continent and almost all are at high latitudes.

For example, Scotland nearly met its target of generating all its electricity through renewable energies in 2020. Similarly, the Scandinavian metropolises are competing on managing the highest carbon emissions. The goal is to achieve carbon neutrality—a balance between carbon emissions and absorption—through guidelines on transport use, energy production and the consumption of raw materials. Copenhagen has long stated that it wants to become the first carbon neutral capital in the world and hopes to hit this target by 2025. Stockholm aims to stop the use of fossil fuels by 2040.

Sustainable Helsinki

A little further east is Helsinki which presents a most interesting example. In the twentieth century, Finland was restrained in its sustainability ambitions to maintain a diplomatic balance in its foreign relations with the Soviet Union. It has since been making up for lost time.

One of Finland's post-war achievements was the incorporation of sustainability into its national development pillars—equality, work-life balance, harmony between city and nature, primacy of public space (as can be seen in the ubiquity of public libraries). This move has allowed a relatively peripheral and sparsely populated nation to steadily prevail in the rankings of the happiest countries in the world.

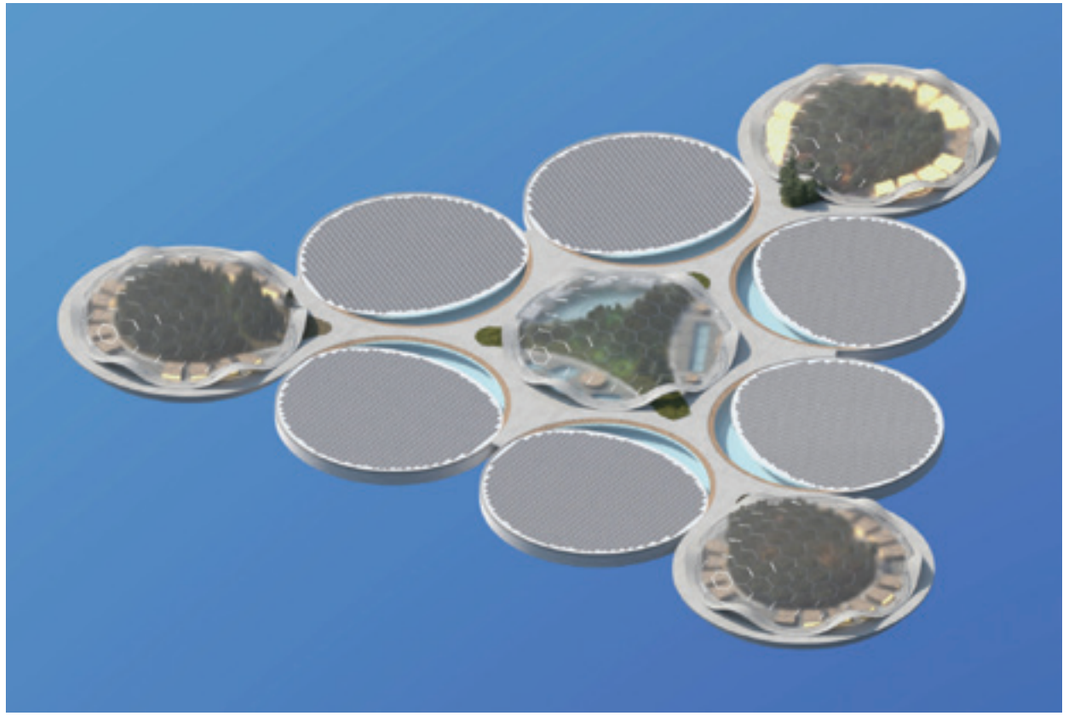
Already in 2019, Helsinki's CO2 emissions were 26% lower than in 1990, despite significant population growth during the same period. However, the city still faces a significant problem—heating—which accounts for more than half of Helsinki's local emissions.

Hot and Coal

The city is also heavily reliant on coal. The closure of coal plants, planned for 2030, is one Helsinki's top concerns and on the local political agenda. While everyone may agree on the goal, the way to get there is less clear.

The remote heating system in Helsinki supplies heat to houses and buildings by utilising excess hot water generated by power plants. How can we transform this colossal metropolitan infrastructure to become sustainable? Besides the technical obstacles, there are neither standard solutions on a similar scale nor comparable examples of good practices to draw inspiration from.

It is from these limits that former Mayor Jan Vapaavuori's brainchild was born. He launched in February 2020 the Helsinki Energy Challenge, a competition to gather technical proposals to accelerate the country's green transition.



Hot Heart
Image: Squint Opera

In just a few months, more than 250 groups from all over the world had joined the competition. One year on, four teams, including the one led by our design studio, CRA-Carlo Ratti Associati, together with a large team of consultants, won the competition.

Our project, called Hot Heart, proposes to collect the hot water used for remote heating in a huge thermal basin floating on the water off the harbour. The thermal basin acts as a huge battery to store energy from renewable sources such as wind (famously strong in Finland). When there is excess thermal energy, the energy will be made available at low or even negative prices for the city's use where necessary.

The Nordic countries have always prized the shared use of public space. The Finnish belief in the right of public access is called *jokamiehenoikeus* (meaning "the right of every person"), and allows, by law, for one to move about freely, set up a tent in public, or collect berries and mushrooms almost anywhere.

Some of the heat collected in the Hot Heart thermal basin can be used to heat the sea water and the air above it. Under a thin, semi-transparent dome, a public space can be created, heated, and illuminated all year round. For example, a tropical archipelago can be developed in the middle of the Baltic Sea, accessible by boat to locals and international visitors. This is one of the ways in which Hot Heart can double up as an accessible recreational venue.

Hot Sauna
Image: CRA-Carlo Ratti Associati graphic team—Gary di Silvio, Pasquale Milieri, Gianluca Zimbardi

Tropical Environment
Image: CRA-Carlo Ratti Associati graphic team—Gary di Silvio, Pasquale Milieri, Gianluca Zimbardi

Important Lessons

What are the lessons learned from Helsinki and its Energy Challenge for the rest of the world?

1. To combat climate change, we need to work as a team, combining different skills and visions.

2. We need to develop innovative new methods. Cities usually work on the basis of best practices—looking at projects that were successful in the past to show us the way to the future—for the procurement of goods and services on an urban scale. This method aims to minimise risks and avoid waste. However, the urgency of the climate crisis and the demographic and social challenges we will face in the near future, call for a different approach.

Hot Heart is showing the international community a way to innovate not only in its objectives, but also in the process. The north wind could soon heat the warm heart of Helsinki, and in the near future, those of many other cities, at all latitudes.

A previous version of this article appeared on Project Syndicate.

BUSAN

An Eco-Friendly Waterfront Smart City Leading the Global Market

TEXT: YANG JUNG-WON

An eco-friendly waterfront of the future is being created in Busan. The Busan Eco Delta Smart City includes a Smart Village, a living lab where people meet advanced technologies for a first-hand experience of future living.

Yang Jung-Won is a General Director of the Korea Water Resources Corporation (K-water) overseeing the Waterfront Utilisation Business Department.

Artist's impression of the Busan Eco Delta Smart City.
Image: Korea Water Resources Corporation

By preserving the valuable ecological resources and maximising the value of waterways, Busan Eco Delta City aims to create an ideal urban habitat for both people and nature.

Busan, the largest port city in South Korea, has successfully transformed into a digital-centred economy to rank as one of the top smart cities in Asia according to the World Smart Centres Index. Busan Eco Delta City (EDC), a project initiated by governmental agencies such as the Korea Water Resources Corporation (K-water), Busan Metropolitan Corporation, Busan Metropolitan City, is pushing boundaries as the new frontier for a smart and eco-friendly waterfront city.

Busan EDC is located at the convergence of three rivers on land that is a rich habitat for migratory birds and designated as a Natural Monument. The riparian zone (or river bank) earmarked for the development of the Busan EDC possesses valuable ecological resources. This raises the question: how can conventional city development models be challenged to ensure that a haven for migratory birds with rich ecological resources can co-exist with urban development to achieve harmony between nature and humans?

Co-Existing in Harmony: Nature, People, Technology

The total area of Busan EDC is approximately 11.7 km^2 with a planned population density of 64.5 people per hectare (10,000 m^2). This is relatively low compared to other new cites in the country. By preserving the valuable ecological resources and maximising the value of waterways, Busan EDC aims to create an ideal urban habitat for both people and nature.

Plans for the city include the development of the largest wetland ecological park in the country (630,000 m^2) and safeguarding of migratory bird-feeding grounds that take up around 66,000 m^2. The building heights for the surrounding areas, especially along the key migration routes, are to be restricted to low-rise.

To maximise the use of water space to create an attractive waterfront living environment, the city plans to minimise artificial structures within a radius of 600 m of the main waterway street. In addition, the city is actively monitoring and carrying out trials using state-of-the-art technologies such as eco-filtering systems to manage the water quality of the rivers to make it suitable for water-friendly activities. Low Impact Development techniques, such as water-sensitive urban design and permeable pavements, will also be adopted to minimise environmental impact from the adjacent built environment.

Smart Water Solutions for a Climate-Resilient City

One of the key challenges in planning for a waterfront city is to ensure that the city is resilient to the impact of climate change and extreme weather conditions like heavy rainfall and flooding. For example, in 2023, Typhoon Khanun's heavy rainfall was the third-highest in the country since 1973.

To testbed and implement multiple smart water management techniques, Busan EDC has been leveraging innovative technology and working in collaboration with K-water which has 50 years of experience in water management and urban development. For example, the city is operationalising high-precision small-scale precipitation forecast radars and integrating the data using the city-level Water Disaster Management and Response System.

This system constantly monitors water levels, water gates, and drainage facilities across the city. The aim is to provide a real-time monitoring system using augmented reality to predict and prevent water-related disasters in urban areas. At the same time, small-scale decentralised water purification plants and smart water-metering technologies are being introduced to provide consumer-centric water services.

Artist's impression of waterfront living at Busan EDC.
Image: Korea Water Resources Corporation

Advancing National Smart City Goals as a Living Lab

In early 2018, the government initiated the National Pilot Smart City project to identify vacant pieces of land for a trial of innovations to support the building of intelligent future cities. The objective was to incorporate the technologies of the Fourth Industrial Revolution (the trend towards automation and data exchange in manufacturing technologies and processes) into daily life, thus creating a fundamental shift in the way people live, work and interact with one another. The pilot project was implemented through collaboration by the public and private sectors, with the public sector being responsible for the quality of services and the private sector taking charge of urban innovation and the building of the business ecosystem.

Selected as one of the National Pilot Smart City projectst, Busan EDC unveiled its first Smart Village in December 2021. Consisting of 56 households ranging from single-person units to three-bedroom homes, the village is a living lab where residence is on a voluntary basis. Besides getting to experience the various advanced technologies that will be implemented in the Busan EDC, residents live rent-free for three years, with an option to extend their stay for two more years, in exchange for feedback and data collection. The data collected will play an important role in assessing and validating the usability of the Fourth Industrial Revolution technologies while the validated innovations from the Smart Village will be expanded for application throughout the Busan EDC.

First residential complex of the Smart City—drone view of the Smart Village.
Image: Korea Water Resources Corporation

Examples of innovative technologies being piloted at the Smart Village.
Image: Korea Communication Agency (KCA)

The Smart Village introduced innovative technologies across five categories. Some examples include:

1. **Water and Environment**—installation of sensors in each household to forecast water usage and provide real-time water quality information to improve the reliability of tap water usage data.

2. **Energy**—development of a Zero Energy House that reduces energy consumption and produces energy on its own using solar power, hydro and geothermal systems, heat storage and Energy Storage Systems to achieve 100% self-reliance rate.

3. **Healthcare**—provision of a smart health monitoring system for each household to offer physical activity care services, and telemedicine services.

4. **Smart Life**—Use of AIs and robots for complex management operations, running of unmanned cafes, and undertaking of security patrols.

5. **Smart Homes**—smart appliances integrated with Internet of Things (IoT) technologies to provide a data-based platform to meet the needs and preferences of various household members.

By creating a new lifestyle with smart technologies and integrating them into daily living activities, Busan EDC is poised to be a model smart city offering a more convenient way of life for future generations.

VIEWPOINT

FREDERICK TEO

Overcoming Challenges to Build Resilient and Future-Ready Cities

"Making cities resilient and future-ready will require substantial investment and collaboration across sectors", says Frederick Teo, Chief Executive Officer of GenZero.

By 2050, 70% of the human population is expected to live in cities. The rapid pace of urbanisation poses unique challenges.

With more than half of the global population living in urban areas, cities are at the frontline in the fight against climate change.

A dense population puts enormous pressure on a city's sustainability, adaptability and resilience. In addition, the climate impact of cities through resource consumption and waste generation is greatly disproportionate—cities occupy only about 3% of the earth's surface, yet they consume around 70% of our global energy.

The Urban Challenge

By 2050, 70% of the human population is expected to live in cities. The rapid pace of urbanisation poses unique challenges.

By adopting sustainable and climate-resilient infrastructure, growing cities can ensure that they are liveable and can cope with climate risks like rising sea levels and extreme weather. At a planning level, urban infrastructure needs to be weather-proofed in anticipation of more frequent extreme weather events that lead to flooding.

For example, the Singapore government launched a S$5-billion coastal and flood protection fund in 2020 to enhance drainage and flood prevention infrastructure. This infrastructure includes seawalls, tidal gates, and revetments to defend against rising sea levels and erosion. Singapore's iconic Marina Barrage is an example of a successful measure that has helped prevent flooding in the low-lying central city area and, at the same time, form a new reservoir.

Across the world, more than 100 countries have pledged to achieve net zero gas emissions, with most aiming to reach this target by 2050. To meet this commitment, the world needs to accelerate the switch to renewable energy sources and low-carbon building materials like low-carbon cement and steel, enhance building efficiencies (e.g. through the use of energy-efficient lighting, heat pumps and district cooling) and adopt other innovative green solutions to scale impact.

New York City is an example of a city undergoing a green transformation. The city was awarded the Lee Kuan Yew World City Prize in 2012 for its holistic systems-based approach to realise

The key is in providing access to capital not only to accelerate the development of new solutions but also fund green infrastructure deployments.

a greener and more resilient urban landscape, given its ageing infrastructure. It adopts an interdisciplinary strategy to synergise land use planning, transportation investment, environmental stewardship, and public health.

However, not all cities have the resources to do the same, and many of the sustainable solutions and technologies needed to achieve net zero by 2050 are still not ready for deployment at scale.

Unlocking Capital to Future-Proof Cities

So how can we fast-track the green transformation of our cities?

The key is in providing access to capital not only to accelerate the development of new solutions, but also fund green infrastructure deployments.

Historically, governments have led such infrastructure financing. However, public capital alone cannot fully bridge the urban-infrastructure funding gap given the high capital expenditure involved. More and more, governments are facing financial constraints with many demands on an increasingly limited public purse. This is where public and private sector collaboration is key.

We need to tap different sources of private capital. Such capital, in the form of corporate investments, venture and growth capital, philanthropic funds, and impact investing, can unlock the potential of transformative ideas. By aligning investment with clear social and environmental objectives, private capital can help drive the development of innovative technologies, and deployment of proven sustainable solutions in new and existing urban infrastructure. This will enable cities to enhance their adaptive capacity, mitigate climate risks, and promote inclusive growth.

Besides private equity, private lenders need to be mobilised to broaden the available pool of capital alongside multilateral development banks that help de-risk urban infrastructure projects, especially in emerging markets.

However, to truly attract private capital, optimising risk-sharing is imperative. Governments can create an enabling environment through clearer regulatory frameworks and attractive fiscal incentives to make Public-Private Partnerships (PPPs) work.

PPPs allow for a more balanced risk-reward outcome between parties while leveraging the expertise and resources of both sides to drive transformative change. For example, Singapore's TuasOne Waste-To-Energy Plant (TuasOne) was developed under a PPP framework to provide waste incineration services to the country's National Environment Agency (NEA) while leveraging the expertise of one of the world's leading industrial groups, Mitsubishi Heavy Industries. TuasOne aims to support Singapore's long-term waste management needs while recovering energy from municipal waste. Located on 4.8 hectares (48,000 m^2) of land, it is the most land-efficient waste-to-energy plant in Singapore generating enough electricity to power 240,000 4-room public housing flats.

Looking Ahead

The story of urbanisation is still being written across the world.

Making cities resilient and future-ready will require substantial investment and collaboration across sectors. The race to secure the well-being of future generations and address climate change has started and will end in cities.

VIEWPOINT

MARCOS ATHIAS NETO

Designed for People: How Cities Can Leverage Technology and Innovation for Inclusive and Sustainable Development

A broad urban innovation toolkit is needed to ensure that no one is left behind, says Marcos Athias Neto, United Nations Assistant Secretary-General, Assistant Administrator and Director of the Bureau for Policy and Programme Support of the United Nations Development Programme (UNDP).

> We need to accelerate a paradigm shift that moves beyond being led by technology, and instead focus on where it can have the greatest value.

We are living in challenging and uncertain times. This year, one in four people in developing economies will be poorer than before the COVID-19 pandemic. Not only was 2023 the hottest year on record, but it was also a year of more conflict and displacement than at any point since World War II. Global inequality has risen while efforts to achieve the UN's Sustainable Development Goals (SDGs) are significantly off-track. At the same time, technologies such as Generative AI have raised both hopes and uncertainties over their transformative potential.

Cities, as local and national engines of innovation and economic growth, will be critical in driving sustainable development. Working across more than 120 countries and territories, the UNDP has seen that technology and innovation in cities, when applied with an inclusive and people-centred approach, can amplify the central role that cities play in the lives and livelihoods of billions of people around the world.

However, there are important, persistent, and growing disparities in the accessibility and application of innovation. These disparities demand a wholesale re-evaluation of how we leverage innovation and technology for urban development.

Paradigm Shift in Urban Innovation and Technology

Often, technology is seen as a discrete solution to complex urban challenges—a panacea to tackle all city challenges. However, cities are increasingly recognising that technology is one tool in the urban development toolkit—one that requires a deeper understanding of the problems that urban residents are facing, and engagement with how technology can play a role in addressing these urban issues.

Central to the consideration of technology is the need to establish a common vision on the path forward, one which ensures that any technology used meets the needs and aspirations of the people it aims to serve. We need to accelerate a paradigm shift that moves beyond being led by technology, and instead focus on where it can have the greatest value.

Such a people-centred perspective requires a broad urban toolkit that includes high-tech, low-tech, or even no-tech solutions, such as nature-based solutions. This reflects the diversity of cities, their populations and priorities.

A rate collector processes a vendor's payment by scanning their QR code.
Image: UNDP The Gambia

More importantly, this approach emphasises the necessity of involving communities from the outset and along the entire journey, recognising the role of each sector and the need for cross-sector collaboration.

Our UNDP team in The Gambia implemented this holistic approach in order to improve the functioning of the local market and increase city revenue collection. They worked closely with the Banjul City Council, private sector traders, and the city's university— exploring behavioural change interventions and analysing the user journey of different stakeholders. After experimentation and piloting of various digital solutions, they introduced digital registration and QR codes for vendor stall identification. This was accompanied by hands-on training for all stakeholders involved. As a result, the city's revenue collection has increased by 25%, and the national government is looking to scale this approach to other regions in the country.

People-Centred Technology and Innovation Put into Practice

A more thoughtful and inclusive application of technology and innovation can have important and exciting multiplier effects.

For example, the Con Vos (meaning 'with you') initiative developed by UNDP in Argentina has shaped a network of local shopkeepers who are actively involved in assisting residents with online administrative procedures, either by guiding them through the process or by handling the procedures on their behalf. As a result, more people in these neighbourhoods are using digital public services. This is saving local residents time and money as they no longer need to travel long distances to government offices. Interestingly, shopkeepers are seeing increased revenue as residents increase their spending when visiting shops for digital support. It has shaped a hyperlocal community-led feedback loop, contributing to reducing the digital divide and fostering digital inclusion.

This grounding of technology and innovation in local contexts and communities is also especially crucial in identifying the challenges that these tools may pose. Digital technologies, in particular, can exacerbate inequality and can also sometimes create new harms or risks. Safeguards that tackle these and related digital issues are essential. Cities, for example, have seen an increase in cyber-attacks ranging from ransomware to data breaches. Recognising this, UNDP is working across cities and countries to map cyber security standards to identify how best to enhance policy, regulation, infrastructure, skills and institutional measures to strengthen cyber security protection at the local and national levels.

> In driving this new way of thinking and working, we can tackle existing urban challenges, engage with new frontiers, and respond to the evolving needs of city residents.

Con Vos (With You) Network in Fray
Image: UNDP Argentina

Cities as Active Players in Driving the Sustainable Development Goals

Having passed the halfway mark toward the 2030 deadline for achieving the SDGs last year, we need to re-double our efforts to get the global community back on track. About 37% of the SDGs are stagnating or even regressing, and only 10% of targets are heading in the right direction for SDG11: Sustainable Cities and Communities.

Technology and innovation can play an important role here if we apply these tools thoughtfully and inclusively. Research by UNDP and the UN's International Telecommunication Union has highlighted, for example, that digital technologies directly help in achieving 70% of the SDG targets.

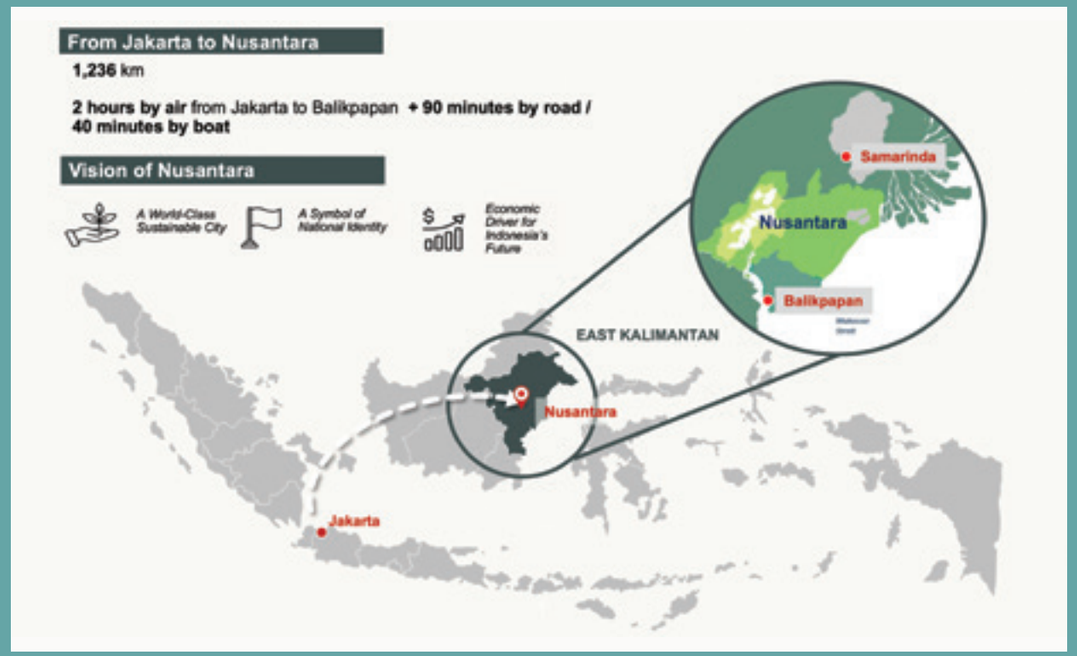
We are reimagining and shaping the future of cities. Inaction is not an option. The current situation demands that we adopt a new paradigm of sustainable urban development—one that emphasises the inclusive and people-centred application of technology and innovation. In driving this new way of thinking and working, we can tackle existing urban challenges, engage with new frontiers, and respond to the evolving needs of city residents. With 2.5 billion more people due to live in cities by 2050, this paradigm shift could not be more urgent.

UNDP is organising a session—Designed for People: Expert Insights on Building Smarter Cities, at the World Cities Summit 2024, on 4 June at 9:00 a.m. Visit UNDP's website to find out more about their work on smart cities and urbanisation.

URBAN TRANSFORMATION
BAMBANG SUSANTONO

Bambang Susantono is the Chairman of Nusantara Capital Authority (OIKN) of the Republic of Indonesia, which is a ministerial-level agency in charge of planning and constructing Indonesia's new capital. Professor Bambang is also responsible for overseeing the government's transition to the new city and eventually becoming its administrator.

Building a Liveable and Lovable City: Nusantara's Urban Transformation



Moving the Capital City from Jakarta to Nusantara.
Image: Nusantara Capital Authority (2022)

Cities are rapidly expanding. Driven by the promise of economic and social prospects, cities often attract a high influx of people. While urbanisation brings enhanced economic opportunities, better access to healthcare and education, and improved living standards, fast urban growth presents its own set of challenges, such as widened economic disparities, diminished social cohesion, and increased environmental concerns.

> The relocation of the capital city to Nusantara is a strategic solution to alleviate the pressures on Jakarta.

There is therefore a pressing need for strategic urban planning and integrated urban development approaches, particularly in Asia. Asia had the highest urban population globally in 2018; its 2.3 billion people represented over 50% of the world's total population. This number is projected to rise to 3.5 billion by 2050 (UN, 2019).

In Indonesia, the current capital city of Jakarta faces significant urban challenges. With over 10 million people in 2022 (Statistics Indonesia, 2024), Jakarta is experiencing several ongoing issues, including traffic congestion, overcrowding, and land subsidence.

The relocation of the capital city to Nusantara is a strategic solution to alleviate the pressures on Jakarta.

> The idea of a 'liveable' city places people and community welfare at the centre of urban development and devision-making.

Nusantara as an Economic Centre

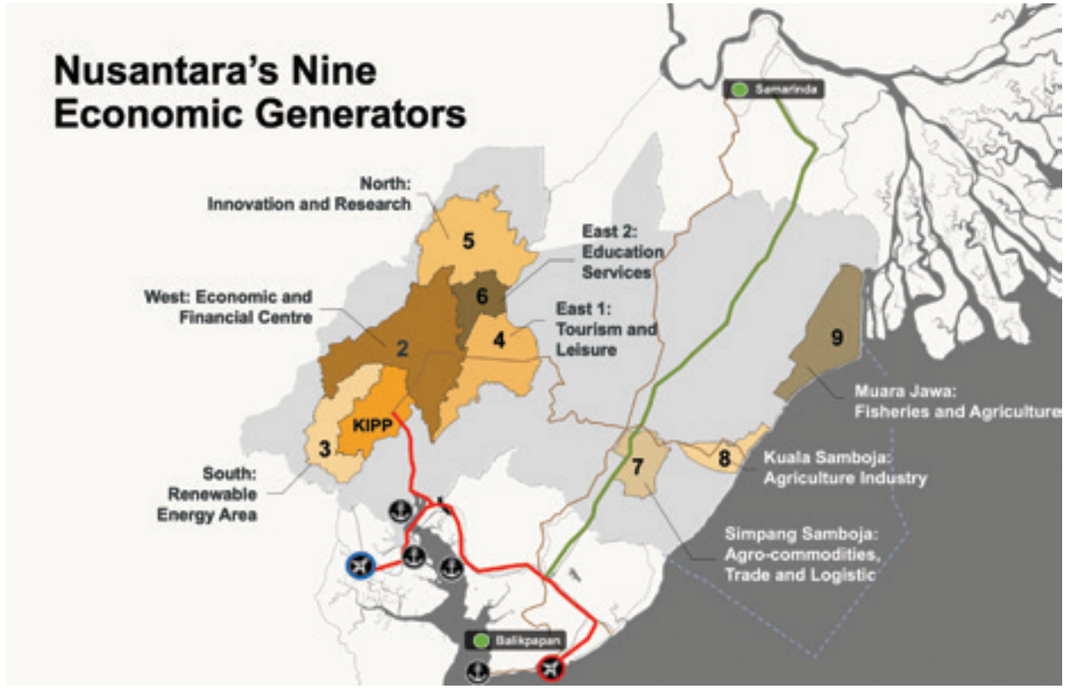
Nusantara aims to become the world's first sustainable forest city while also embodying national identity. Nusantara seeks to be a new economic growth centre in Indonesia, bridging the gap between the western and eastern regions of the country and providing economic opportunities for all.

Besides its primary function as the government centre, Nusantara has several economic generators, such as renewable energy, innovation and research.

Nusantara's Urban Transformation

To build the liveable and lovable city we envision, we need to create in Nusantara functional urban environments that cultivate a sense of belonging.

The concept of "liveability" in urban contexts is widely understood to refer to the quality of life and well-being of a place with robust governance systems and equitable access to efficient urban services and quality infrastructure. The idea of a liveable city places people and community welfare at the centre of urban development and decision-making.



Nusantara's economic generators.
Image: Nusantara Capital Authority (2022)

In transforming Nusantara, we take a 5D approach to incorporating five important aspects into city planning:

Design	Spatial design needs to be reviewed to make it more decentralised and resilient to economic, financial, health and climate change shocks.
Density	There needs to be a new balance for ideal population density in an area, supported by technology that encourages efficiency.
Diversity	Efforts are needed to maintain inclusivity, such as encouraging the development of mixed-use buildings, walkable cities and 10-minute cities.
Digitalisation	Digi-life becomes the new normal and opens new opportunities for the economy, education, health, and work.
Decarbonisation	The importance of low-carbon living is increasingly felt, and cities must have specific and measurable action plans to tackle climate change.

5D approach for a sustainable liveable city.
Image: Susantono (2023)

> A 'lovable' city goes beyond mere functionality by embracing cultural diversity, fostering vibrant social interactions, and nurturing a sense of belonging.

In addition to being a liveable city, a "lovable" city must go beyond mere functionality by embracing cultural diversity, fostering vibrant social interactions, and nurturing a sense of belonging that cultivates a deep emotional connection between citizens and their surroundings. Deloitte (2021) describes a lovable city as a humane city, emphasising inclusion, connection, attachment, stimulation, freedom, and agency as key aspects.

Nusantara's transformation into a world-class city for all is based on its unique concepts of a forest city, sponge city, and smart city.

Forest City

The forest city concept is based on the idea that developing Nusantara and preserving the environment can coexist. The principles of Nusantara as a forest city include:

- Zero deforestation
- Biodiversity
- Conservation
- Carbon stock increase
- Indigenous and local community involvement
- Sustainable forest management
- Governance
- Land use improvement

> Nusantara's transformation into a world-class city for all is based on its unique concepts of a forest city, sponge city, and smart city.

The benefits of a forest city concept.
Image: Presidential Regulation Number 63 of 2022

The forest city concept is a nature-based solution, with a land use plan allocating nearly 200,000 hectares (2,000 km^2) (around 65%) of the area to natural forests and marine reserves which comprise green (terrestrial) and blue (aquatic) zones. Around 10% of Nusantara's land will be dedicated to sustainable food production while only 25% will be designated as highly-controlled urban areas to minimise carbon footprint and emissions. The remaining 75% will be earmarked as green spaces, with 65% of those to be made up of tropical forests.

The forest city concept can be achieved by optimising knowledge and technology, involving communities and the forging of collaboration by diverse stakeholders to offer numerous economic, social, and environmental advantages. These include the creation of green employment opportunities, increased resilience to climate change, and the conservation of biodiversity. The benefits offered by Nusantara's forest city concept are diverse, ranging from economic and social to environmental.

The three principles of the sponge city.
Image: Nusantara Capital Authority (2022)

Sponge City

A sponge city is able to restore and maintain the natural water cycle which changes with alterations in land cover and function.

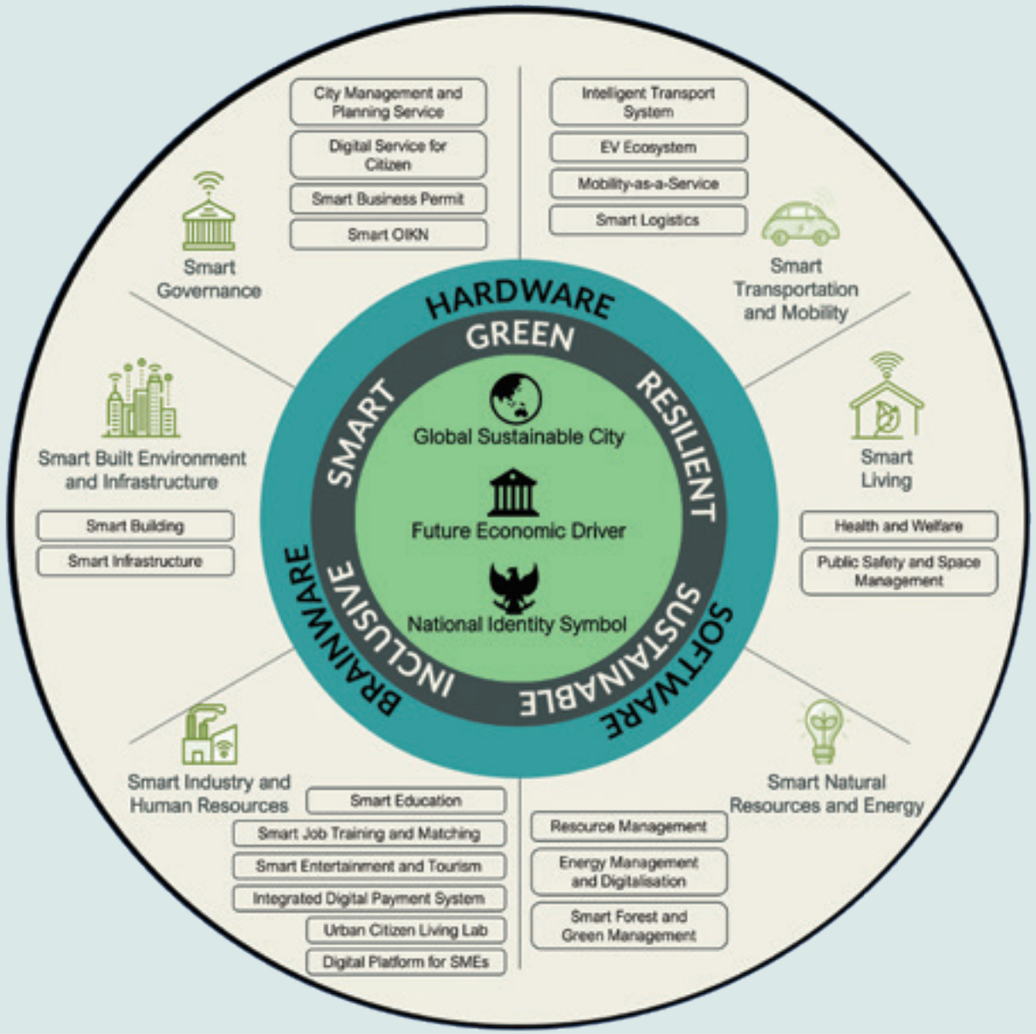
Implementing the sponge city concept will yield several benefits, including water purification, ecological preservation, increased water availability and reduced flood risks, and economic, social, and cultural advantages for society. Nusantara's sponge city concept is based on the principles of an archipelago city, absorbent city, and integrated city.

- **Archipelago City**
  Green and blue open spaces form the foundation of the city and allow for greater connectivity with and integration of nature into its urban design to maintain and preserve biodiversity.
- **Absorbent City**
  Green and blue open space corridors are designed to capture rain runoff, which is then collected and channelled to city parks. By acting like sponges, the parks allow rainwater to be absorbed and filtered to replenish aquifers (underground layers of water-bearing material), thereby maintaining balance in the ecosystem.
- **Integrated City**
  The sponge city integrates different levels of city planning, ranging from the smallest scale of individual buildings and neighbourhoods to the broader urban scale. This approach will more effectively help restrain water flow, harvest rainwater, and increase rainwater absorption into the soil.

Smart City

As a smart city, Nusantara seeks to harness digital innovations and data-driven solutions to redefine urban living, fostering an interconnected city centred around its citizens. Nusantara aims to do this by incorporating multiple domains of a smart city that include:

- **Smart governance**–Nusantara prioritises effective and transparent governance through features such as digital identity, integrated operation centres, citizen-reporting systems, and smart administration. These features provide citizens access to government services and enable city authorities to make informed decisions, paving the path for a more responsive and accountable administration.



Nusantara Smart City
Image: Nusantara Capital Authority (2023)

> Nusantara not only seeks to overcome its challenges, but also endeavours to set a precedent for urban development across Asia.

- **Transportation and mobility**—the Intelligent Transport System consists of an autonomous driving system, urban air mobility, and an advanced traffic management system that will improve safety, reduce congestion, and optimise traffic management. Efficient smart logistics systems utilising advanced digital technology will streamline the movement of goods, leading to faster and more sustainable supply chains.

- **Smart living**—initiatives focusing on citizen well-being aim to enhance quality of life through smart features, providing services for public safety, health, culture, and leisure.

- **Smart natural resources and energy**–this domain delves into the role of technology in reshaping the utilisation of natural resources. Natural resources encompass materials or components found in nature that humans harness to fulfil our needs. This domain focuses on ensuring sustainability in water resource management, waste recycling, renewable energy, and biodiversity monitoring.

- **Smart industry and human resources development**—promotes innovation and skills enhancement by supporting economic growth through small and medium-sized enterprise (SME) platforms, technology centres, and citizen living labs. The application of advanced technology in the industrial sector aims to boost operational efficiency and offer more flexible responses to market changes. The human resources domain adopts an upskilling approach to prepare our workforce to navigate the industrial landscape.

- **Smart built environment and infrastructure improvement**—this domain includes facility management systems, internet access propagation and smart infrastructure systems to enhance liveability and sustainability.

Conclusion

Asian cities are grappling with the challenges caused by rapid urbanisation. Jakarta, the current capital city of Indonesia, is no exception. By relocating our capital to Nusantara, we hope to create a city that is both liveable and lovable. Nusantara not only seeks to overcome its challenges, but also endeavours to set a precedent for urban development across Asia.

URBAN RESILIENCE AND CLIMATE CHANGE

BARBARA NORMAN

Professor Norman is a global expert in sustainable cities and regions, smart infrastructure, coastal planning, climate change adaptation and urban governance. She is an Emeritus Professor of Urban & Regional Planning and Chair of the Urban Policy Forum advising the Australian Government.

Urban Resilience and Climate Change: Innovative Solutions

“Cities are hubs of innovation and human ingenuity—and potential centres for transformative action to implement the Sustainable Development Goals and build a zero-carbon, climate-resilient and socially just world.” United Nations Secretary General, World Cities Day 2021.

> Cities consume around 75% of the world’s energy and produce more than 75% of all carbon emissions. Cities are also experiencing very substantial impacts to life and property from extreme weather events.

How cities can adapt to and enhance resilience to climate change, highlighting Australia.

Cities and climate change is now a central theme in global discussions. The 28th meeting of the Conference of the Parties (COP) to the United Nations Climate Change Conference (COP 28) and the Intergovernmental Panel on Climate Change (IPCC) clearly recognise the huge importance of both reducing emissions from urban settlements and planning for the impact of climate change with appropriate adaptation measures. Cities consume around 75% of the world’s energy and produce more than 75% of all carbon emissions. Cities are also experiencing very substantial impact to life and property from extreme weather events (Norman et al. 2018, p. xv). The planning and design of cities and urban settlements has gained greater importance because this is where a substantial impact can be made in relation to climate change.

The recent 2023 IPCC report stresses the significance of climate resilient development through the integration of adaptation and mitigation, international cooperation, financial support for vulnerable regions, and inclusive governance. The IPCC announced

> Investing in strategic planning to clearly identify through climate projections land that is suitable for development and land at risk from climate change is essential to minimise risks to current and future urban communities.

in November 2023 a forthcoming special report, Climate Change and Cities, while COP 28 concluded the importance of "increasing the resilience of infrastructure and human settlements to climate change impacts to ensure basic and continuous essential services for all, and minimising climate-related impacts on infrastructure and human settlements" (UNFCCC 2023, s28 63e).

Across the globe, there is a groundswell of climate action at the local and regional level, often with national support in the form of a national urban policy including climate change. Global organisations including the UN's Environment Programme, the United Nations Framework Convention on Climate Change (UNFCCC), UN Habitat, and the Organisation for Economic Cooperation and Development have active programmes for supporting and implementing climate resilient development. These programmes range from sharing implementation frameworks that can be applied locally to direct funding for resilience projects.

Challenges

While reducing greenhouse gas emissions is critical to minimise impact on current and future communities, adapting to the impact of climate change is of equal concern. We have seen several extreme weather events in the last few years, such as drought and extreme heat, coastal storms and flooding, and in some cases, a convergence of events has resulted in enormous costs to life and assets. The UN's SDGs continue to provide a clear framework for global to local implementation (for example, SDG 11 on sustainable cities and communities). Embedding climate change action into the framework at the urban level is a priority.

In my recent book, *Urban Planning for Climate Change* (Norman 2022), I outline these essential actions in response to the current challenges to change:

- Mapping of risks
- Community engagement
- A range of planning tools including scenario planning
- Mandatory consideration of climate change in all land use planning
- Nature-based solutions
- Collaboration
- Capacity building and training
- Climate-induced resettlement
- Indigenous knowledge
- Investing in forward strategic planning

It is critical that climate information is up to date and made public and accessible for communities to make informed decisions on building and development.

Ways and Opportunities

There are many ways and opportunities to build resilience to climate change. These include:

1. Investing in strategic planning, to clearly identify through climate projections land that is suitable for development and land at risk from climate change, is essential to minimise risks to current and future urban communities. Including climate change considerations in planning legislation and infrastructure developments will ensure that mistakes are not made early on and can, as a result, save considerable costs in the future.

2. Developing climate-sensitive built environments is an excellent opportunity for innovation with multiple benefits for urban communities. Designing for the transition to a net zero or, preferably, a carbon positive built environment should be the goal. Possible innovations in this area include water-sensitive urban design to cool the urban environment, the use of recycled materials in construction, solar roof tops for renewable energy, rooftop gardens and recycling waste management.

3. A combination of the above is the creation and maintenance of healthy green and blue infrastructure for the spaces between buildings. Creating wetlands for storm-water management adds to urban amenities and the reduction of the impact of urban heat islands. Investments in landscape and quality open spaces are good for the climate, residents, and biodiversity, resulting in a healthier place to live and work (CLC 2019).

4. Space for renewable energy and active travel such as walking, the use of bikes, light rail, or electric charging, is essential in any new developments or when retrofitting existing urban developments. Redeveloping older suburbs with well-designed medium density to offer a greater diversity of housing choices provides the opportunity to implement more climate-sensitive sustainable urban development.

These are examples of ways in which opportunities can be created through good precinct planning at the block level, or at the level of the neighbourhood or suburb or regional centre.

A Look at Australia

The Australian Government is developing a new national urban policy to address urgent challenges facing our major cities. It is advised by a national Urban Policy Forum (of which I am Chairperson) comprising wide representation and supported by a dedicated Cities Unit focusing on climate change and contemporary urban challenges. Providing policy guidance with sub-national governments and industry to develop a more climate-resilient future is an important step, as is a funded grant programme for precinct planning.

Innovative solutions in Australia can be found at all levels of government, in industry and community groups– some examples of leading practice to illustrate what's possible with good planning, policy, partnerships and collaboration can be found below.

Decarbonised Precincts
At an industry level, the Green Buildings Council of Australia (GBCA) is leading the way with its roadmap for decarbonised precincts. The GBCA identifies key steps, including:

- Embedding climate positive pathways into all stages of planning

- Committing to fossil-fuel-free precincts and ensuring policy and planning processes support this ambition

- Removing barriers to low carbon precinct energy solutions

Low angle view of apartment buildings with vertical gardens and heliostat with motorised mirrors, Central Park residential building on Broadway, Sydney, Australia.
Image: mamember / iStock

- Driving lower upfront carbon in materials and construction activity

- Committing to delivering low carbon buildings in all precincts (GBCA 2024)

To support the GBCA roadmap, considerable research is being undertaken to aid the implementation of low carbon precincts with detailed pathways and examples of leading practice (Curtin University 2023).

Green and Blue Infrastructure
The provision of green and blue infrastructure is critical to reduce the impact of the urban heat island. Australia has a solid history of leading-edge practice in water-sensitive urban design. Integrating wetlands, restoring concrete waterways to natural landscape water courses all help to cool the environment and offer considerable benefits to the local communities through improved urban amenity and healthier urban environments.

The City of Sydney Urban Forest Strategy takes a comprehensive approach to landscaping the urban environment, bringing three key elements—growth, equity, and resilience—together with four key directions: an integrated forest, a growing forest, a forest for all and a resilient forest. This approach is supported by a species list and planting guide for city residents. The resilient forest direction focuses on planting and maintaining a more diverse urban forest of different species and ages to improve its sustainability and minimise overall risk from disease and the impact of climate change (City of Sydney 2023, p9). There are also excellent urban forestry plans for a number of major cities, notably Melbourne and Canberra (City of Sydney 2024; Australian Capital Territory [ACT] Government 2019).

An important step towards more climate-resilient urban settlements is the provision of smart infrastructure for public transport and active living.

Active Living and Smart Infrastructure
An important step towards more climate-resilient urban settlements is the provision of smart infrastructure for public transport and active living. Integrating active living infrastructure into new urban construction and retrofitting existing suburbs is an essential step for climate-sensitive development, both help to reduce emissions and adapt to a changing climate.

There are excellent examples of active living in Australia, such as the active living strategy for Canberra, known as Active Travel Plan 2024-2030. This is supported by a Design Guide detailing the "best practices for intersections and other active travel infrastructure in the ACT" (ACT government 2024).

Jacaranda flowering in the gardens in Central Melbourne.
Image: Zoya_Avenirovna / iStock

Canberra, Australia, 4 May 2016. Autumn arrives in Canberra, trees become multicoloured around Lake Burley Griffin.
Image: Daniiielc / iStock

There are five key priorities of the Plan:

1. Safe infrastructure for people walking and riding
2. A better connected and maintained walking and riding network
3. Support for new types of active travel
4. Making active travel and bicycle parking easy
5. Supporting behaviour change and working with communities

An example of a non-government initiative is the Heart Foundation of Australia's Blueprint for an Active Australia (Heart Foundation 2019). The blueprint brings together active living, health, and climate-sensitive urban environments, with a key focus on the built environment. Key elements recommended for retrofitting neighbourhoods include mixed land use, medium higher densities, and "design neighbourhoods with high levels of street connectivity, diverse lot sizes and dwelling types, access to amenities and increased natural surveillance" (op cit. p18).

Conclusion

Around the world are many examples of innovation to develop cities, towns and suburbs that are more resilient to climate change. With clear goals, targets, and collaboration, we can all work towards developing more liveable, prosperous, and healthy urban communities and environments.

ESSAY

URBAN RESILIENCE AND ADAPTATION
DAN HILL

Dan Hill is Director of Melbourne School of Design, the graduate school in the Faculty of Architecture, Building and Planning at the University of Melbourne.

Navigating Systemic Change

Khoo Teck Puat Hospital with integrated biodiversity.
Image: Khoo Teck Puat Hospital

We stand before unprecedented systemic challenges. The scale of change required by us is only matched by its complex nature. It is becoming ever clearer, everywhere, that the immediate challenges of everyday life are increasingly entwined with shared global systemic challenges, such as climate change, public health, social cohesion, and economic sustainability.

These challenges are not isolated to specific cities but are shared by urban centres worldwide, necessitating a shift from localised decision-making to a more holistic, systemic approach.

Singapore's Capabilities Can Describe Future Resilience

In this, Singapore presents a singular example. It has faced previous challenges through strategic capability-building, resulting in both coherent action and system resilience, developing an ability to respond to ongoing change. It has moved through the developmental gears smoothly, rapidly progressing for individuals, businesses and communities while maintaining levels of trust in government that most administrations can only dream of.

However, the Centre for Climate Research projected that Singapore could experience a rise in daily mean temperatures of up to 4.6°C towards the end of this century, along with more intense and frequent heavy rain and a mean sea level rise of up to 1 m. These findings are concerning for Singapore's public health, social cohesiveness, economic livelihood, and food security.

Singapore also relies on global networks for foundational provisions like energy, food and building materials, and is experiencing a demographic slowdown. All these factors contribute to increasing volatility and ambiguous risk profiles that make strategic long-term investment problematic.

In the face of these challenges and risks, the steps Singapore takes could be a useful reference for countries making system transitions, for the current model of importing foundational resources is no longer ideal. This applies to all of us, even among the more developed countries also known as the Global North.

For example, a typical Swede's climate footprint—around nine or 10 tonnes despite Sweden's increasingly sustainable operational emissions—is well beyond the global average and must be reduced to around 1 tonne by 2050. Many of those emissions occur outside of Sweden's formal national borders, yet we must now recognise that such borders are largely irrelevant to shared global challenges.

> This requires a radical shift towards circular regenerative systems, both local and global.

Transport and Housing in Singapore as Systems

Singapore's success in managing transport and housing systems, to this point, allows us to reflect on its capability for systems thinking while speculating about future resilience.

While the Economist Intelligence Unit frequently lists Singapore among their "world's most expensive cities" survey findings, the results are largely based on equating transport costs with the ownership costs of private cars—a most 20th-century idea. The survey does not capture the broader public value resulting from radically reducing the number of private cars on the road—which is instead a necessary 21st-century move. The cost of owning a car in Singapore directly relates to the societal cost of car ownership. In this sense, vehicle-permit systems are a sign of good leadership, not bad.

Large cities like Singapore and Tokyo have around 0.3 cars per household. By contrast, countries like USA or Australia have car ownership rates of around 1.8 cars per household. If we take a societal and systemic perspective, rather than an individualistic one, Singapore and Japan would be examples of how to transition to a mobility future comprising public, shared and active transport.

Singapore's high-quality public transport costs relatively little by global standards. Of course, riding a bike is lower cost again—in energy, material, and spatial terms too—and Singapore could move significantly further in this direction given its density, climate, and living patterns, now multiplied by the transformative capabilities of e-bikes (for both people and logistics).

On top of that, Singapore's approach to ensure physical mobility is linked systemically to the city's urban design and planning policies and practices. The foresight of Singapore's public housing strategy is increasingly recognised worldwide, as most other cities struggle with this most basic of urban elements. Since the late 1960s, Singapore has developed public housing on government-owned land. Its public housing blocks are designed and planned to integrate with facilities and public transport.

With the majority of its population living in public housing, the Singapore government enabled value uplift of its land for the common good. In this aspect, the scale and output quality of public housing by the government agency in charge, the Housing & Development Board (HDB), is perhaps parallel only to Vienna.

Transitions to Circular Regenerative Systems

So Singapore clearly "does systems". And yet challenges remain. Generally speaking, construction, of housing, commercial property and infrastructure, is perhaps our most extractive sector globally, with impacts not only on greenhouse gas emissions, but also on biodiversity, ecosystem loss and population displacement. Hence, to provide housing that does not exacerbate the climate crisis, we need to explore the transition to circular regenerative systems.

In buildings, this means switching the focus from operational emissions to the reduction of embodied emissions, and focusing on radically minimising extractive processes upstream of construction and occupation. The Danish Reduction Roadmap suggests that embodied carbon in housing will need to be reduced by as much as 90%.

Another way to achieve low-carbon housing is by not constructing many new buildings at all, and instead transitioning towards zero-carbon retrofits and reallocation of existing under-used space. In either case, construction materials must be reworked fundamentally around biomaterials or from recycled materials saved from existing construction or agricultural waste streams.

This requires a radical shift towards circular regenerative systems, both local and global. Indeed, where production cannot be local, a systems-stewardship approach must ensure circular and regenerative activities elsewhere. We can no longer ignore what the Australian geographer Val Plumwood called the "shadow places" that produce the materials that the Global North relies upon, usually through highly disruptive processes across much of the Global South, but stay out of sight and out of mind.

Denmark was recently estimated to be only 4% circular overall, which reinforces the sheer magnitude of the shift needed. It is not possible to frame such a transformation as simply an engineering challenge; it is a fundamental question of re-design, and a reorganisation of our societies, industries, economies, and systems of governance.

Naturally-cooled green city.
Image: Mark Stoop / Unsplash

Redeploying Strategic Assets

Existing publicly-owned assets which can take on multiple functions—like housing, streets, schools, public spaces—can be thought of as "strategic levers" from a system design perspective. Singapore's greatest lever might be the housing and neighbourhoods built by the HDB. Their key issue now, as many buildings approach the end of their original leases, is how to cultivate these approaches to retrofit over new-build by using circular biomaterials.

There are numerous emerging examples of building innovation that could work here. For example, if timber, in its myriad forms, is prioritised, then carbon capture is an outcome of building, alongside its further benefits in terms of health, adaptability, and aesthetic qualities.

Cities and forests can become symbiotic carbon sinks. Singapore's forests have been decreasing in recent decades due to population growth. Perhaps this could be reversed by focusing on using and re-using timber as a building material? Given an ageing population, the balance may swing towards fewer, lower, and higher quality timber buildings, immersed in walkable and accessible green public spaces. The question for Singapore is: how might the goal of making a building also achieve the goal of making a forest?

In terms of innovation levers for the HDB, that parallel with Vienna's public housing may be interesting. Having helped establish the energy-efficient building standards of "Passivhaus" and the use of mass timber structures, perhaps Vienna can steer the transition of its industries towards a more sustainable supply of construction materials.

These more careful links between buildings and materials suggest substantial mindset shifts, requiring us to practise long-term stewardship of our housing, the built environment and neighbourhoods by using circular and regenerative practices.

Car-free streets.
Image: Bna Ignacio / Unsplash

> How might local-scale community-oriented action positively affect the wider global systems that they rely on for the everyday?

Social and Cultural Transitions

For neighbourhoods made up of utilities, social and cultural infrastructures, and biodiverse public spaces, examples of mindset shifts include the:

- Generation, use and storage of fully renewable energy as locally as possible, instead of energy from imported fossil fuels—this requires innovation in both demand and supply
- Greater emphasis placed on locally-grown food
- Use of land, water and what we currently call waste (human and otherwise) in reworked nutrient cycles

Again, the transition to these circular regenerative systems is not easy as they present not only technical challenges, but also social and cultural ones. Yet, embracing the complexity of social and cultural change might be part of the answer to building future resilience.

Singapore recently announced a range of strategies to adapt to the rising temperatures in their tropical climate zone. These include designing buildings and neighbourhoods woven with natural green and infrastructure and also raising awareness among its population of the impact of rising temperatures.

In assessing Singapore's climate readiness, The Lancet recently published research describing the need for future studies to better understand how "community knowledge, attitudes and practices would improve the design and focus of community initiatives to reduce the risk of heat-driven adverse health outcomes." We might add, how might such local-scale community-oriented action positively affect the wider global systems that Singapore relies on for the everyday?

> Can Singapore reorient its considerable expertise in long-term strategy and quality delivery towards upstream challenges?

Future Cities as Global Actors

Can Singapore reorient its considerable expertise in long-term strategy and quality delivery towards upstream challenges, moving well beyond the mitigation of local operational impacts and the management of reliable supply chains?

This would require systems stewardship, predicated on more careful relational rather than transactional approaches to these resources and flows, along with new forms of economic thinking and practice. In addition, Singapore would need to reorient its enviable capabilities in mobility, housing, technology and governance to address their global and local impact. So the question for Singapore is not only whether it can evolve and transform its approach to genuine systems transformation at home, but do so in a way that produces good outcomes elsewhere too.

Singapore's strong public sector capacity, together with continuing efforts to design, build, and maintain its everyday public infrastructures, could help this city state retain its strategic levers to address systemic challenges. And yet, the scale of the challenges now facing Singapore, and other cities, far surpasses that experienced during their earlier developmental stages.

Traditional approaches to urban policy-making and delivery will yield only limited and ineffective outcomes. The decision-making cultures that produced the climate crisis are unlikely to be those that can reverse it.

Recognising that decisions taken by cities of the future are not confined to political and geographical boundaries, but enmeshed in global flows of resources will take systems acting and thinking—at local and global scales simultaneously.

CASE STUDY

GLOBAL | MARITIME SUSTAINABILITY

Navigating the Future of Port Cities

As vital hubs for international transport, ports have rich histories of enabling commerce and connectivity. Six iconic port cities share with us how they are innovating to ensure adaptability, sustainability and climate resilience.

Tan Suan Jow has been the Dean of MPA Academy since 1 April 2017. He also holds the appointment of Chief Knowledge Officer. Prior to these appointments, Mr Tan was MPA's Director (Shipping Division) and Director of Marine as well as Director (Sustainability Office).

Port cities have long been vibrant hubs that play a crucial role in local and global trade, commerce and connectivity. Through the decades, port cities have withstood the test of time and continue to ride the waves of change in sustainability and integration, and face new challenges from climate change.

As a global hub port and leading international maritime centre, Singapore has been spearheading efforts in digitalisation and decarbonisation towards a more sustainable and low-carbon future for the global maritime industry. Singapore's port terminals will transit towards a low-carbon future, through the adoption of cleaner energy, automation and digitalisation. By 2030, our port terminal operators aim to collectively achieve a reduction of at least 60% of total emissions from port operations compared with 2005 levels, and to reach net zero emissions by 2050.

Singapore is also fostering a culture of innovation and sustainability across the maritime ecosystem. The Maritime and Port Authority of Singapore (MPA) has been relentless in driving initiatives to promote green shipping. At the international front, Singapore has been actively establishing green and digital shipping corridors with like-minded partners to pilot digital solutions and decarbonisation initiatives along trade routes. The port city is committed to leading the charge towards a greener, more sustainable maritime future.

> Each city's journey serves as a testament to the resilience and adaptability of port cities in an ever-changing world.

Driving Maritime Innovation and Sustainability

In the face of new global challenges and opportunities, the visionary transformation of five other iconic port cities offers a glimpse into the evolving landscape of urban maritime integration and sustainability. We take a look at how the unique history, challenges, and aspirations of Antwerp, Barcelona, Cape Town, Shanghai and Yokohama are shaping their efforts to ensure future resilience.

Antwerp's ambitious riverbank renewal and visionary infrastructure projects like The Big Link illustrates how climate adaptation can harmonise with urban liveability. Barcelona's exemplary efforts towards synergising port activities with urban life and fostering blue economy innovation showcase how a strategic vision can lead to sustainable growth and environmental stewardship.

Steeped in maritime history, Cape Town is embracing the blue economy with initiatives like the Blue Cape that catalyse economic growth while preserving marine ecosystems. Shanghai's relentless pursuit of port infrastructure excellence, exemplified by the Yangshan Deep Water Port Phase IV, shows its dedication to advancing efficiency and connectivity in global trade. Meanwhile, Yokohama is spearheading initiatives like its carbon-neutral port and international collaborations, leading the charge towards a greener and more sustainable future for port operations.

From urban renewal to environmental conservation, from economic growth to technological innovation, each city's journey serves as a testament to the resilience and adaptability of port cities in an ever-changing world.

Let us draw inspiration from the collective vision and ingenuity of these port cities, to chart a course towards a more sustainable, connected, and resilient future for urban maritime integration.

Advancing Tuas Port's Digitalisation and Decarbonisation

Tan Suan Jow has been the Dean of MPA Academy since 1 April 2017. He also holds the appointment of Chief Knowledge Officer. Prior to these appointments, Mr Tan was MPA's Director (Shipping Division) and Director of Marine as well as Director (Sustainability Office).

Singapore's Tuas Port will be developed in four phases and was officially opened on 1 September 2022. When completed in the 2040s, Tuas Port will be automated, intelligent and sustainable, with a handling capacity of 65 million twenty-foot equivalent units (TEUs), almost double the volume handled in 2021.

Sustainability is integral to Tuas Port's design, planning and construction. For instance, excavated earth from other land construction projects and dredged materials were reused as reclamation fill for the port. In addition, the port operator, PSA, aims to achieve net-zero carbon emissions by 2050. To that end, PSA has constructed green buildings such as the Administrative Building at Tuas Maintenance Base, which uses 58% less energy compared to other similarly-sized buildings and is Tuas Port's first super low-energy building. Moreover, PSA will rely on electrified equipment for port operations and implement smart grid solutions and battery energy storage systems to optimise energy use.

Tuas Port is envisioned to be the world's largest fully automated port when completed.
Image: PSA Singapore

Automation and Digitalisation

The port will feature smart technology to make it more efficient, productive and sustainable. Automated yard cranes, drones, and electric and driverless automated guided vehicles, which reduce carbon emission by about 50% compared to current diesel prime movers, will be deployed to enable safer and more efficient transport of containers between the berth and yard. Furthermore, terminal operations are remotely controlled and monitored by smart computer systems, improving labour productivity and creating better jobs for port workers.

Predictive analytics provide real-time information to better coordinate, plan and allocate resources under the Just-In-Time initiative while minimising the ships' idling time and emissions in the port. Tuas Port will be digitally integrated within the supply chain, improving the coordination of cargo flows in a secure and intelligent manner, and helping supply chain players save costs, and time, and enjoy greater convenience. Digitalisation offers immense potential to help vessels access various marine services such as bunkering, supplies and repairs, more efficiently. The port is also exploring the use of drones for maritime applications like remote ship inspections and ship supply deliveries.

Artist's impression of the future Tuas Port—targeted to be completed in the 2040s.
Image: Maritime and Port Authority of Singapore

CASE STUDY

> **Tuas Port will feature smart technology to make it more efficient, productive and sustainable... Terminal operations are remotely controlled and monitored by smart computer systems.**

Singapore is the first port in the world to implement electronic bunker delivery notes, boosting efficiency and transparency during the bunkering process. This can save close to 40,000 man-days a year and enhance crew safety by eliminating the need for physical transfers for bunker documents between vessels.

Cybersecurity and Decarbonisation

In addition, Tuas Port is using digitalisation to enhance safety in the port. MPA established the Maritime Cyber Assurance and Operations Centre (MCAOC) to assist our agencies, research institutes, shipping community and industry to collectively secure the cyber domain against emerging and sophisticated cyber threats. Through collaboration with maritime stakeholders, the MCAOC provides real-time cybersecurity monitoring and disseminates information on cyber threats and systems recovery measures. On top of that, the MCAOC identifies possible vulnerabilities including onboard ships in due course, to strengthen incident prevention and response measures.

Tuas port will feature smart technologies such as automated yard cranes, drones, and electric and driverless automated guided vehicles.
Image: PSA Singapore

Automated guided vehicles are capable of moving cargo efficiently and securely while being greener and more sustainable compared to diesel prime movers.
Image: PSA Singapore

MPA is also actively supporting and driving maritime decarbonisation through several key initiatives. These include the Maritime Singapore Green Initiatives, transitioning to electric harbour craft, and developing multi-pathways for future marine fuels like ammonia and methanol. Additionally, MPA is driving international collaboration for climate action and promoting carbon awareness, accounting, and green financing for maritime companies.

A Future-Ready Port

Tuas Port is set to revolutionise port operations through the implementation of automation, predictive analytics, and smart technologies to make it more efficient, productive and sustainable.

Representing the future of Maritime Singapore, Tuas Port will be the nexus of a well-integrated ecosystem comprising the business and industrial districts in the western region of Singapore, such as the Jurong Lake District, Jurong Innovation District and the Tuas Industrial District. By co-locating complementary sectors that have synergies with the port, relevant industries can tap on Tuas Port's global connectivity with greater ease and efficiency.

River Scheldt Right Bank Renewal: Combining Climate Adaptation with Liveability

Koen Kennis is the Vice Mayor for Mobility for the City of Antwerp.

Tom Verbelen is the Director of External Relations and International Affairs for the City of Antwerp.

To reconnect the city with the river, the city of Antwerp drafted a masterplan for the large-scale renewal of the right bank quays of River Scheldt. The plan comprises customised solutions for seven sub-areas that include the raising of flood defences to prevent fluvial flooding and create space for residents. This entire process will take 15 years to complete.

Recreation area on the renewed Sint-Andries and Zuid quay.
Image: © AG Vespa, Sigrid Spinnox

Reviving the Historical Link with Water

In the North, the right bank quays lead to the Droogdokkenpark, an 11-acre (44,515 m^2) area by River Scheldt, combining green space with a maritime experience based on the history of the Antwerp port. The first part of this soon-to-be developed park—The Bélvedère—was completed in 2019 and features a 2-acre (8,094 m^2) hexagonal vantage point with spectacular views over the river and the port.

The southern sub-areas that have already been completed–the Sint-Andries and Zuid quay area—include a large, open floodplain with two sports fields, a skate park and playgrounds with expansive views over the river and a green linear park on the city side. The Zuid quay is connected to the recently developed Zuidpark–a three-tier park where the old shipping docks used to be, thereby reinstating the historical link to the city's port activity and creating an enormous green climate adaptive space with integrated water retention measures.

A render of the future Ringpark Groenendaal on top of the covered ring road.
Image: © BUUR part of Sweco – Latz + Partner – Bureau Greisch – Studio\Woodroffe\Papa

> Increased liveability and climate preparedness go hand in hand on the Antwerp waterfront.

The Big Link: Reconnecting the City with its People

Like the River Scheldt renewal plan, the Big Link project aims to create green space and enhance the liveability of the city of Antwerp, while significantly improving the mobility in and around Antwerp by partially covering the Ring Road.

Known as the largest infrastructure project of this century in Europe, the Big Link seeks to reconnect its people and communities with the city. This far-reaching plan for a complete redesign of the ring road area was the result of a massive co-creation process involving citizens, stakeholders, interest groups and representatives at different government levels.

The project aims to meet diverse future needs through its reclamation of hundreds of acres of space and partial transformation of the heavily congested Antwerp ring road area. For example, the creation of an extensive green-blue landscape will create new ecosystems and provide recreational services, substantially reduce the impact of Ring Road traffic, improve air quality and lower noise levels while reconnecting the inner and outer city districts.

Scheduled for completion in 2030, the Big Link project is unparalleled in size, complexity and impact. The development of seven ring parks and a bridge for pedestrians and cyclists across the River Scheldt will fundamentally improve the spatial structure and functioning of the city.

Barcelona's Visionary Transformation: Leading the Way in Port-City Integration, Sustainability, and Innovation

Javier Garrido Salsas is the Innovation Manager at the Port of Barcelona. He has pursued a PhD focused on studying the impacts of major trends in the port sector and the transition towards a new generation of green and digital ports, including a case study on the Port of Barcelona Vision 2040.

Barcelona's journey towards an integrated, sustainable, and innovative port-city landscape began in the 1980s, gaining significant momentum as the city prepared for the 1992 Olympic Games. This visionary initiative by the Port Authority of Barcelona, in partnership with local, regional, and national authorities, marked a pivotal shift. By relocating port activities away from urban centres, the port authority enhanced the synergy between the port and the city, improving urban liveability while preserving Barcelona's maritime heritage and setting a new standard for urban maritime integration globally.

"Your Port Opens Up Again"

The foundation laid during the early years paved the way for the port's 2021-2025 Strategic Plan, known as "Your Port Opens Up Again". The ambitious project aims to deepen the relationship between the historic port and Barcelona. This initiative focuses on reorganising passenger traffic and moving ferry and cruise terminals to a dedicated passenger wharf in the commercial port.

This move will not only streamline operations, but will also play a crucial role in reducing the port's environmental footprint. In addition, the project envisions the transformation of the northern end of the port into a vibrant hub for leisure, education, innovation, and research on the blue economy, dramatically reducing the port's environmental footprint.

BlueTech Port

At the heart of this strategic vision is the BlueTech Port project, designed to establish the port as a leading centre for maritime technology and research. The initiative focuses on fostering the development of the blue economy by supporting startups and established companies across various sectors. These sectors include:

- Marine renewable energies
- Sustainable maritime navigation
- Marine biotechnology
- Sustainable aquaculture
- Sustainable coastal and marine tourism

By developing an ecosystem that encourages innovation and collaboration, the BlueTech Port project aims to create forward-thinking solutions to meet global maritime challenges, demonstrating Barcelona's commitment to combining economic growth with environmental sustainability.

BlueTech Port's future lies in the Naus Sant Bertran, a complex of six interconnected former port warehouses located near the Drassanes square. These warehouses, which will occupy a total area of 23,000 m², are strategically positioned to support Barcelona's growth and to advance the global blue economy. The location is part of a broader plan to establish a comprehensive ecosystemic campus dedicated to blue economy innovation, which will also serve as the headquarters for the new BCN Port Innovation Foundation.

Such strategic and architectural planning highlights the Port of Barcelona's commitment to innovation, sustainability, and the promotion of the global blue economy. By creating a dedicated space for companies, startups, and research initiatives focused on marine and maritime technologies, BlueTech Port is poised to become a cornerstone in the development of sustainable economic models that attract global investors and hub management specialists.

Aerial view of the port city area and the cruise wharf.
Image: Port of Barcelona

> By fostering a symbiotic relationship between marine activities and urban life, the city sets a global benchmark for innovative, sustainable, and inclusive urban maritime integration.

Barcelona, the Port City

This collaborative and strategic approach not only reinforces Barcelona's position as a global leader in the blue economy, but also emphasises the city's dedication to sustainable growth, environmental stewardship, and technological advancement.

Barcelona's port-city transformation journey illustrates a holistic approach to urban development, sustainability, and innovation. By fostering a symbiotic relationship between marine activities and urban life, the city sets a global benchmark for innovative, sustainable, and inclusive urban maritime integration.

This initiative not only reaffirms Barcelona's rich maritime heritage, but also highlights its future as a leader in maritime innovation and sustainability. Through these strategic efforts, Barcelona demonstrates how cities can embrace their historical ties to the sea while paving the way for a sustainable and innovative future, thus serving as a model for port cities worldwide.

The Cape of Storms

Mayor Geordin Hill-Lewis has been the Executive Mayor of Cape Town since November 2021. Prior to this role, he served as a member of the National Assembly for the official opposition, the Democratic Alliance, for more than a decade.

Cape Town boasts a beautiful harbour with a rich maritime history that spans centuries. Situated in the Cape of Storms, the harbour was established in 1652 as a victualing (food-supplying) station for the Dutch East India Company. It has since transformed into a multifaceted port that is critical to the region's export industry, serving as a vital junction for cargo moving between Europe and the Western Hemisphere, as well as the Middle East and Australia.

The Cape Town Port is run nationally through the Transnet National Ports Authority (TNPA) and enjoys good rail and road connections inland to many other South African cities.

Cape Town's Blue Economy

According to estimates from the African Union, the blue or ocean economy presently brings in close to US$300 billion for the continent and supports 49 million employment opportunities. In 2019, the City of Cape Town, in partnership with the V&A Waterfront, officially launched Blue Cape, a non-profit organisation and strategic business partner to maximise the economic contribution of the blue economy for the city.

The rise of Cape Town as a leading catamaran producer and a cost-effective supplier to global markets has spurred demand for skilled professionals in the yacht and boat-building industry. This growth has favourably positioned the city to enhance economic returns within the supply chain, particularly in supporting visits by superyachts, by providing high-quality berthing, victualling, maintenance, and entertainment services.

A Busy Harbour

The vision for the Cape Town harbour aligns with the city's broader objectives of sustainable development, economic growth, and job creation. To achieve this, the port authorities are focusing on modernising infrastructure, enhancing stakeholder engagement, and operational efficiency.

During the past cruise season, Cape Town welcomed 70 ships, with 145,000 passengers and 42,000 crew passing through the Cape Town Cruise Terminal. The Cape Town Cruise Terminal, a dedicated cruise terminal developed in 2018, was funded by the V&A Waterfront which has proven to be a worthwhile venture that is already showing a massive return on investment.

Although there has been a 30% global reduction in ocean freight rates since 2021, Cape Town did not experience a similar decline. The City of Cape Town, together with the Western Cape Government and TNPA, are actively engaging stakeholders, including the private sector, to enhance port efficiency and hold the national government accountable.

Aerial view of Port of Cape Town.
Image: City of Cape Town

Drive to Increase Efficiency

To improve freight movement efficiency and alleviate port congestion, the TNPA has identified several measures. These include:

- Traffic impact assessments and engagement with key stakeholders within the maritime transport logistics chain to establish a truck holding area and enhance enforcement against illegally parked trucks.
- Investments in improved software to optimise the traffic flow between the port and terminal gates.
- Piloting and scaling up of technical equipment to stabilise vessels during adverse weather conditions and reduce operational inefficiencies caused by wind disruptions.
- In-depth research to develop a more accurate predictive model for wind, to mitigate the impact of strong winds and improve the overall operational efficiency of the port.
- Spearheading of the development of the precinct and the land adjacent to the port to integrate the port, road and rail logistics and back-of-port facilities, to enhance storage capacity, and enable more effective movement of cargo in and out of the port.

Looking Ahead

The City of Cape Town has an urban planning mandate and is highly invested in improving the urban design of the port precinct, as well as assessing alternative sites for the current in-land intermodal terminal.

As the current location of the terminal in a key economic node for the city is hampering urban regeneration, TNPA together with the City of Cape Town is assessing sites on the city's periphery where there is good road access to the port as feasible alternatives. The City of Cape Town is also conducting research, including analysis of freight movement and the logistics economy, to enhance efficiency of back-of-port operations.

Shanghai Port

The Shanghai Municipal Transportation Commission is in charge of the planning, construction, development and management of transportation in Shanghai, China.

Shanghai Port is committed to enhancing its capacity, promoting green shipping, and embracing digital transformation to maintain its position as a world-class port city of the future.

After a hiatus due to the COVID-19 pandemic, Shanghai Port became the first port in China to resume international cruise transportation.

In 2023, Shanghai Port's container throughput exceeded 49 million TEUs, making Shanghai the top container port in the world for the 14th consecutive year—container routes in Shanghai cover over 700 ports in more than 200 countries and regions around the world.

To ensure its quality standards as a world-class port city of the future, Shanghai Port focuses on three key areas.

On the ground at the world's busiest container port.
Image: Shanghai Municipal Transportation Commission

Enhancing the Capability of the Port Hub

To increase the capacity of its port infrastructure, Shanghai Port is optimising the functional layout and intelligent upgrade of the port areas. In addition, it is supporting the development of the north side of the Xiaoyangshan area. It also aims to play a more active role in regional economic development and ensure the stable and smooth operations of industrial and supply chains.

Aerial view of the Port of Shanghai's new terminal.
Image: Shanghai Municipal Transportation Commission

Strengthening Cooperation in Green Shipping

Shanghai has always integrated sustainable development into all aspects of its port and logistics and is committed to becoming a leader in the ecological development of global ports.

In 2023, the Port of Shanghai and the Port of Los Angeles Green Shipping Corridor combined efforts to drive maritime sustainability through voluntary cooperation under the framework of emission reduction established by the International Maritime Organization.

The jointly-released Port of Shanghai-Port of Los Angeles Green Shipping Corridor Implementation Plan Outline will showcase:

- Advanced logistics technology
- Decarbonisation applications
- Best management practices
- Creation of a model of global cooperation for sustainable development in the shipping industry

Building a Digital and Intelligent Port

Shanghai is actively promoting the digital and intelligent transformation of its port, such as the use of new technologies like 5G (fifth-generation technology standard for cellular networks), IoT, cloud computing, big data, artificial intelligence and blockchain.

As part of its future efforts, the Yangshan Deep Water Port Phase IV—the largest and most automated container terminal in the world—will focus on building the digital twin system of a port and the Shanghai International Container Transportation Service Platform. It will also explore public data sharing and interaction to realise the digital integration of its port, shipping and trade, and create a leading digital service platform for international shipping.

The Port of Yokohama—Towards Carbon Neutrality

The International Affairs Bureau handles the general coordination of the City of Yokohama's international affairs, promotes mutual exchange and collaboration, and actively supports the development of municipal diplomacy.

In the face of complex world issues including climate change, cities must create unique solutions and share ideas through networking and collaboration. As the traditional gateway for people, new technologies, products and ideas, ports play a more significant role than ever in an uncertain future.

Yokohama, a global city with a diverse population of 3.77 million, has been one of Japan's earliest international hubs since 1859. Home to the largest logistics port in Japan, Yokohama aims to lead as a decarbonisation model for major cities. To this end, the Port of Yokohama has identified carbon-neutral initiatives that promote collaboration among civil society, the private sector, and other Asian cities.

Night view of Yokohama Port.
Image: Port of Yokohama Cruise Ship Photo Contest

Carbon-Neutral Port

To transform the Port of Yokohama into a carbon neutral port, the port authorities are introducing the use of next-generation energy sources. This includes the creation of a supply chain for hydrogen and its derivatives, such as methanol and ammonia. At the same time, the private sector, academia, and government are working together to promote the decarbonisation of electricity supply and actively implement hydrogen and other next-generation energy sources.

In December 2023, the City of Yokohama Port and Harbor Bureau and the Ministry of Land, Infrastructure, Transport and Tourism of Japan signed a Memorandum of Understanding to establish a Green Digital Shipping Corridor with the Maritime and Port Authority of Singapore.

View of Yokohama.
Image: © Hideo Mori

Local and International Collaboration

As a port city, it is crucial for Yokohama to consider carbon dioxide absorption in the waterfront area. In 2014, Yokohama was one of the first municipalities in Japan to start a blue carbon[1] project which it is promoting in collaboration with residents. Yokohama will continue to act as a leader for blue carbon in Japan.

As an innovator of urban solutions, the city is sharing ideas and technologies with other Asian cities to realise carbon neutrality through platforms such as the Y-PORT (Yokohama Partnership of Resources and Technologies) programme as well as conferences and exhibitions that attract a global audience.

For instance, last November, Yokohama hosted Y-SHIP 2023, an international convention that aims to achieve open innovation by inviting professionals and businesses involved in green transformations. At the convention, Yokohama shared its urban solutions for carbon neutrality, including port-oriented ones, with a wide global audience. Furthermore, at the 12th Asia Smart City Conference, which was held concurrently with Y-SHIP with the cooperation of the World Bank, Asian Development Bank, and other international organisations, the City of Yokohama declared its solidarity to co-create a sustainable and resilient zero-carbon future together with 44 overseas cities and government organisations, including the Bangkok Metropolitan Administration.

In three years' time, Yokohama will host the GREEN × EXPO 2027 (International Horticultural Expo 2027, Yokohama, Japan), a world-class expo. The expo focuses on sustainability and well-being, and how the natural environment and biodiversity can coexist with humans' social and economic activities. Held in the verdant setting of Kamiseya in Yokohama's suburbs, the GREEN × EXPO will also showcase green transformation and nature-based solutions to achieve carbon neutrality.

[1] Coined in a 2009 report by the United Nations Environment Programme, blue carbon refers to the carbon captured by living organisms in oceans and stored in the form of sediments from mangroves, salt marshes and seagrasses.

CENTRAL BUSINESS DISTRICTS | ADAPTIVE REUSE

The Future of Downtowns— An Evolving Identity

The traditional centres or main business and commercial areas of a city are being redefined along with lifestyle changes and diversifying needs.

> The transformation of CBDs into Cultural Business Districts reflects a paradigm shift in urban development. It's about creating vibrant, inclusive spaces where economic vitality intertwines with cultural richness.

Chintan Raveshia is a Director at Arup and leads their Cities Business across Southeast Asia and heads the Centre for Climate Actions in Cities. Arup is a global sustainable development consultancy formed by a collective of 18,500 designers, advisors and experts working across 140 countries.

Downtowns, also referred to as Central Business Districts (CBDs) in some parts of the world, are essential components of a city's economic fabric, typically contributing 10% to 20% of its GDP. Despite facing challenges such as the COVID-19 pandemic and the global financial crisis, the economic significance of downtowns has remained constant over the past few decades. However, measuring the success of downtowns and CBDs now extends beyond economic metrics.

Today, the vitality of downtowns and CBDs is assessed by its vibrancy, connectivity, and cultural appeal, a shift underscored by the pandemic as communities seek more meaningful urban experiences. Recognising this, city officials worldwide, including those from major cities like Chicago and Los Angeles, advocate for the integration of residential spaces into downtowns. This strategy is gaining traction as the demand for commercial spaces wanes, urging a move towards adaptive reuse.

The rationale is evident: incorporating residential units transforms downtowns into dynamic communities, fostering a sense of ownership among residents and nurturing a unique identity. This is vital for city centres traditionally focused on attracting global talent and businesses. However, achieving the delicate balance between economic growth and preserving local character presents a challenge for urban planners.

Business or Pleasure

Focusing on the term "CBD", we must embrace CBDs as more than just *Central* or *Business* or *District*. CBDs must evolve to meet the diversifying needs of their communities while retaining their distinct essence. Every CBD aims to offer distinctive cultural experiences but true cultural identity resides within its inhabitants. To realise this, CBDs could become our Cultural Business Districts.

The transformation of CBDs into Cultural Business Districts reflects a paradigm shift in urban development. It's about creating vibrant, inclusive spaces where economic vitality intertwines with cultural richness.

As we navigate this evolution, it's crucial to recognise the pivotal role our downtowns and CBDs play in shaping the identity and cohesion of our cities, and to champion their transformation into dynamic hubs of community and creativity.

Charting a New Future for Downtown Chicago

Kenya K. Merritt serves as Chicago's Deputy Mayor of Business and Neighborhood Development. Bringing over 20 years of experience as a public service executive, she has been tasked to promote wage growth, entrepreneurship, and investment for all of Chicago's 77 neighbourhoods.

The Riverwalk in downtown Chicago.
Image: City of Chicago

More than 20 years have passed since Chicago adopted the 2003 Central Area Plan, a guide for continued growth and sustainability for the city's downtown. Now, Mayor Brandon Johnson and the Chicago Department of Planning and Development (DPD) are undertaking a major community-driven update to shape downtown Chicago's next phase: the 2024 Central Area Plan Update.

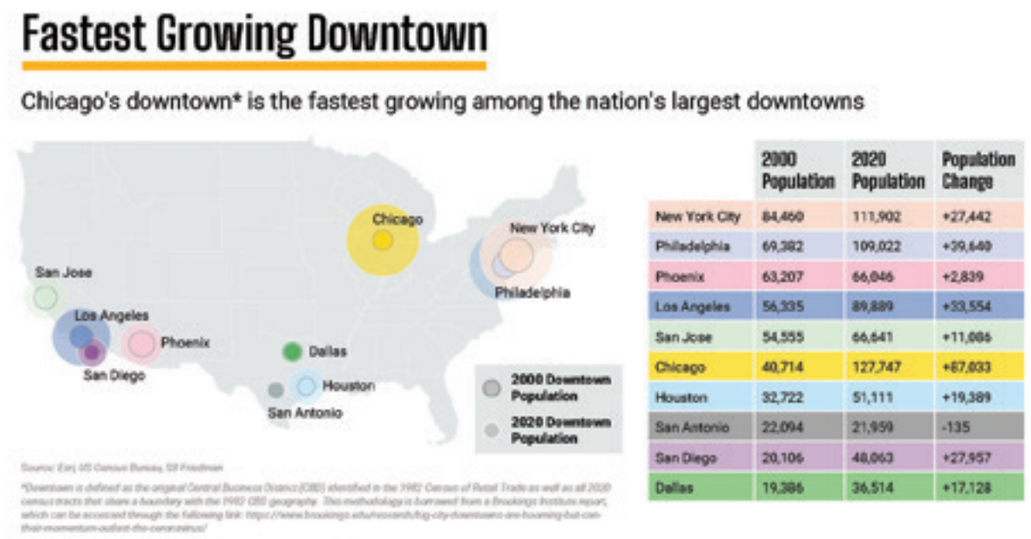
Besides the COVID-19 pandemic and resulting widespread lifestyle changes such as remote work, online shopping and ride sharing, economic insecurity and growing calls for climate resilience have impacted downtown Chicago significantly. Though the 2003 plan catalysed population, job and tourism growth through numerous public improvements, such as better transit connectivity, and the development of the Riverwalk, Millenium Park, world-class museums and a vibrant theatre district, the City saw the need to adapt the plan to address contemporary challenges.

Downtown (Chicago) continues to thrive as an accessible cultural hub with the fastest growing population among the nation's largest downtowns.

Community Engagement

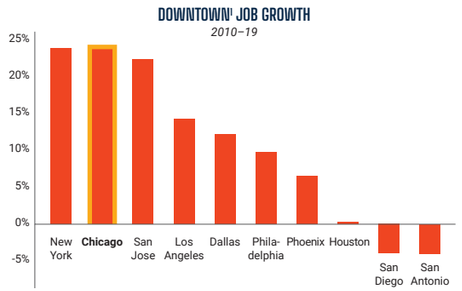
In 2023, DPD analysed downtown Chicago's existing conditions and published guiding vision statements through a robust community engagement process utilising neighbourhood festivals, online surveys, and strategies. To reach out to the city's youth, DPD conducted a survey that identified increasing free or low-cost event offerings as a priority for 63% of youth respondents. At the end of the year (which marked the halfway point of DPD's two-year planning process), nearly 6,500 people had provided input.

The resulting Existing Conditions and Trends Report, published in December 2023, confirmed that downtown continues to thrive as an accessible cultural hub with the fastest growing population among the nation's largest downtowns. Nearly 80% of survey respondents agreed that the central area is easy to access. Since 2010, more than 60 million square feet (5.6 km^2) of development has been completed or is under construction—in 2022, 64% of that total investment encompassed residential uses. And in 2023, downtown set a record-high weekend hotel occupancy rate of 97%, due to a combination of conventions at McCormick Place Convention Center, the James Beard Awards, Blues Fest and a three-night Taylor Swift residency at Soldier Field.



	2000 Population	2020 Population	Population Change
New York City	84,460	111,902	+27,442
Philadelphia	69,382	109,022	+39,640
Phoenix	63,207	66,046	+2,839
Los Angeles	56,335	89,889	+33,554
San Jose	54,555	66,641	+11,086
Chicago	40,714	127,747	+87,033
Houston	32,722	51,111	+19,389
San Antonio	22,094	21,959	-135
San Diego	20,106	48,063	+27,957
Dallas	19,386	36,514	+17,128

Figure 1. Chicago's Fastest Growing Downtown Population From 2000-2020.



Source: LEHD, SB Friedman

1. Downtown is defined as the original Central Business District (CBD) identified in the 1982 Census of Retail Trade as well as all 2020 census tracts that share a boundary with the 1982 CBD geography.

Figure 2. Chicago's Downtown Job Growth From 2010-2019.

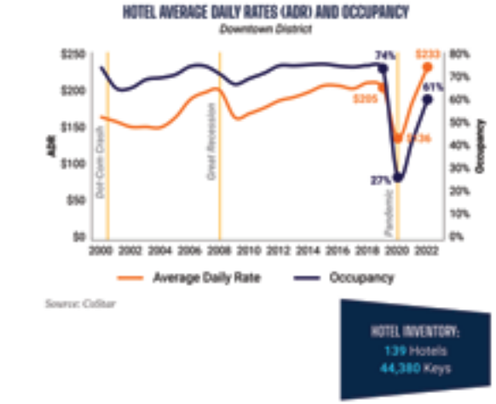


Figure 3. Chicago's Downtown Hotel and Visitor Data.

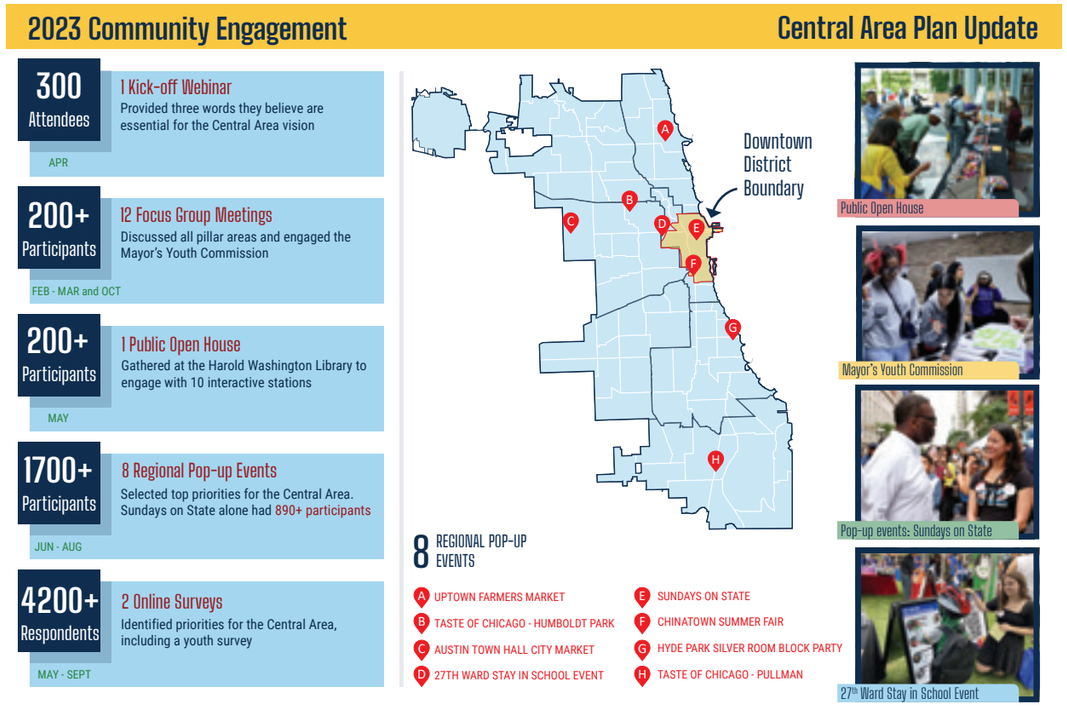


Figure 4. Chicago's Community Engagement in 2023 for the Central Area Plan Update.
Image: City of Chicago

> Survey respondents chose public safety and infrastructure improvements, more affordable housing options and the activation of closed storefronts as their top priorities.

Affordability and Vacancy

DPD's analysis also illuminated some of downtown Chicago's key challenges: affordability and vacancy.

Only 10% of Chicago's downtown rental units are affordable (either via public subsidy, or are "naturally occurring affordable" due to sufficiently low unsubsidised market rent levels), compared with 47% citywide. And like other post-pandemic downtown cores across the country, retail and office vacancy rates are at record highs and continue to increase in the Chicago Loop, the centre of Chicago's downtown.

When asked to state their priorities for the next five years, Chicagoans' answers mirrored the challenges identified; survey respondents chose public safety and infrastructure improvements, more affordable housing options and the activation of closed storefronts as their top priorities.

Next Steps

The Johnson Administration is already implementing key initiatives to address the high retail and office vacancy rates, as well as the limited affordable housing options downtown.

The City is providing, for the first time, Small Business Improvement Fund grants to locally owned businesses for permanent improvement of downtown retail spaces. This funding programme has been used throughout Chicago neighbourhoods, but until now had not been applied in the downtown core.

The City is also reviewing several development proposals to help with conversions of under-utilised office buildings within the Loop's historic financial district for mixed-income housing. These adaptive reuse proposals, once approved and implemented, would create hundreds of new affordable housing units in the heart of the historic financial district while reducing the glut of older office buildings in the central Loop through residential conversions.

By the end of 2024, additional public feedback will inform the formal creation of the recommendations and implementation strategies of the 2024 Central Area Plan Update. The plan will then be presented for adoption by the Chicago Plan Commission. Once the plan is adopted, City Hall will facilitate implementation through policies, legislation, budgeting and coordination to fulfil its vision. The goals and objectives of the 2024 Central Area Plan Update will be created collectively—by Chicagoans for Chicagoans—for a more equitable and resilient heart of the city.

Whither the Future of Downtown Los Angeles

Richard Kent Green is a Professor in the Price School of Public Policy and the Marshall School of Business at the University of Southern California.

Downtown Los Angeles (DTLA) has wonderful amenities, including seven Michelin star restaurants, an excellent concert hall (featuring a world-class orchestra) and art museum, and art deco architecture on its older streets of Broadway, Spring Street, and Main Street. It is also the most transit-rich node in a metropolitan area of 13 million people, boasting transport facilities such as a subway, light and regional rail, bus rapid transit, and frequent traditional bus services.

But DTLA is currently at a turning point, as work from home has rendered obsolete many of its office buildings, some of which were struggling even before the COVID-19 pandemic. Empty towers, together with open streets and struggling retail space, all contribute to perceptions of danger. DTLA is also famous for its concentration of homeless people, particularly around an area in the southern part of downtown known as Skid Row.

Yet the promise of downtown lies in its proximity to many other economic centres of Los Angeles and its relatively low cost (it is still expensive compared with many other American cities, but less expensive than neighbourhoods to its west). The key to the future success of DTLA is to continue its move towards becoming a predominantly residential neighbourhood.

Looking north on Broadway at Olympic Blvd in downtown LA. Adaptive reuse apartments on the right.
Image: Professor Richard Kent Green

The key to the future success of DTLA is to continue its move towards becoming a predominantly residential neighbourhood.

The Broad Museum on North Grand Ave in downtown LA.
Image: Professor Richard Kent Green

Becoming Residential

Around the world, we have seen central cities transform from industrial and office use to residential neighbourhoods with good amenities. Williamsburg in Brooklyn, Tribeca in Manhattan, central Manchester in the UK, Kwun Tong in Hong Kong are examples of such transformation.

DTLA has been moving in this direction for some time. Various sources show that residential population growth tripled between 2000 and 2020 (from roughly 30,000 to roughly 100,000, with the number depending on the exact definition of downtown). While this growth may appear impressive, DTLA's more than 100,000 people make up only one percent of the residential population of Los Angeles County. Only in the past 15 years has the population reached a point where the area can support two full-service grocery stores.

> Under its Adaptive Reuse Ordinance, nearly any building in DTLA may be converted to residential use, so long as the reuse happens within the existing building envelope.

The Grand, a new residential development that includes affordable housing in downtown LA near major arts centres.
Image: Professor Richard Kent Green

Adaptive Reuse

Much of DTLA's population growth resulted from adaptive reuse, which converted non-residential space into more than 12,000 apartments. Continuing this sort of development will be essential to DTLA's future, as much of the neighbourhood's footprint is now non-residential.

Conversions are, in many respects, more complex than new construction. Office building floorplates, ventilation, plumbing, and elevator placements are often incompatible with residential development. Leases in place and finances also present obstacles to redevelopment.

For example, a tenant takes up a substantial chunk of an office building and has a long-term lease. To convert the building, the building owner must either buy out the tenant, including any relocation costs, or wait until the lease expires before carrying out conversion work. Mortgaged office buildings may have covenants that prevent building-use conversion.

One impediment that the city of Los Angeles removed from the redevelopment of its downtown is zoning. Under its Adaptive Reuse Ordinance, nearly any building in DTLA may be converted to residential use, so long as the reuse happens within the existing building envelope.

LA City Hall.
Image: Professor Richard Kent Green

Important Change Factors

For DTLA to continue to grow and to thrive, two things need to change:

1. **Safety**—the perception that DTLA is unsafe has foundation. According to the USC Lusk Center's Neighborhood Data for Social Change maps, DTLA has unusually high crime rates (particularly violent crime), by the standards of the city and county of Los Angeles. DLTA can only fulfil its growth potential if it becomes safe.

2. **Transport**—DTLA needs to take advantage of its rich transit infrastructure to better connect to employment centres (particularly those with healthcare facilities and essential services). Beyond the fact that driving is not environmentally sustainable, morning commutes from DTLA to surrounding job centres and evening traffic tend to be slow. The light rail train from DTLA to Santa Monica, a vital job centre near the Pacific Ocean, should take less time than driving. Still, its headways (the time between trains) are considerably longer than train headways in similarly sized cities.

Trains have already spread to many parts of the region, and more are coming soon. But to be a desirable alternative to driving, train services must become frequent, reliable, clean, and perceived to be safe.

Downtown LA has the bones to be a desirable residential neighbourhood which, in my view, applies to other downtowns around the world. Dense central living can support a wide variety of amenities, which, in turn, will attract more to choose central living.

ILLUSTRATION

URBAN NATURE

Science and Technology to Advance City in Nature

To enhance Singapore's liveability while mitigating the impacts of urbanisation and climate change, the City in Nature vision seeks to conserve and extend Singapore's natural capital island-wide, and further integrate nature into the city. Science and technology play a key role in enabling these transformative efforts.

TEXT: REKHA MOHAN AND GERVAIS LEE (NATIONAL PARKS BOARD)

As a result of sustained greening and conservation efforts that have spanned over 60 years, Singapore is one of the greenest cities in the world and home to a rich diversity of flora and fauna despite being a small city-state of 728 km^2 and one of the most densely populated countries worldwide.

Today, Singapore is advancing into a City in Nature, to further restore nature into the country's urban fabric so as to provide a high-quality living environment for Singaporeans amid increasing urbanisation and climate change. Led by the National Parks Board (NParks), the City in Nature vision builds on Singapore's greening efforts over the past decades, and is also part of a whole-of-nation sustainable development agenda under the Singapore Green Plan 2030.

To achieve this vision, NParks is embarking on a suite of island-wide strategies to

- Conserve and extend Singapore's natural capital
- Intensify nature in gardens and parks
- Restore nature into the urban landscape
- Strengthen connectivity between Singapore's green spaces
- Enhance veterinary care and animal management

Underpinning these strategies is a strong emphasis on science and technology, to inform and equip the planning, design and management of Singapore's natural capital. This entails advancing research across wide-ranging disciplines—from botany and ecology to the climatological and social dimensions of urban nature—so that NParks can continue to effectively integrate nature into an increasingly complex urban environment and address a greater diversity of challenges and needs.

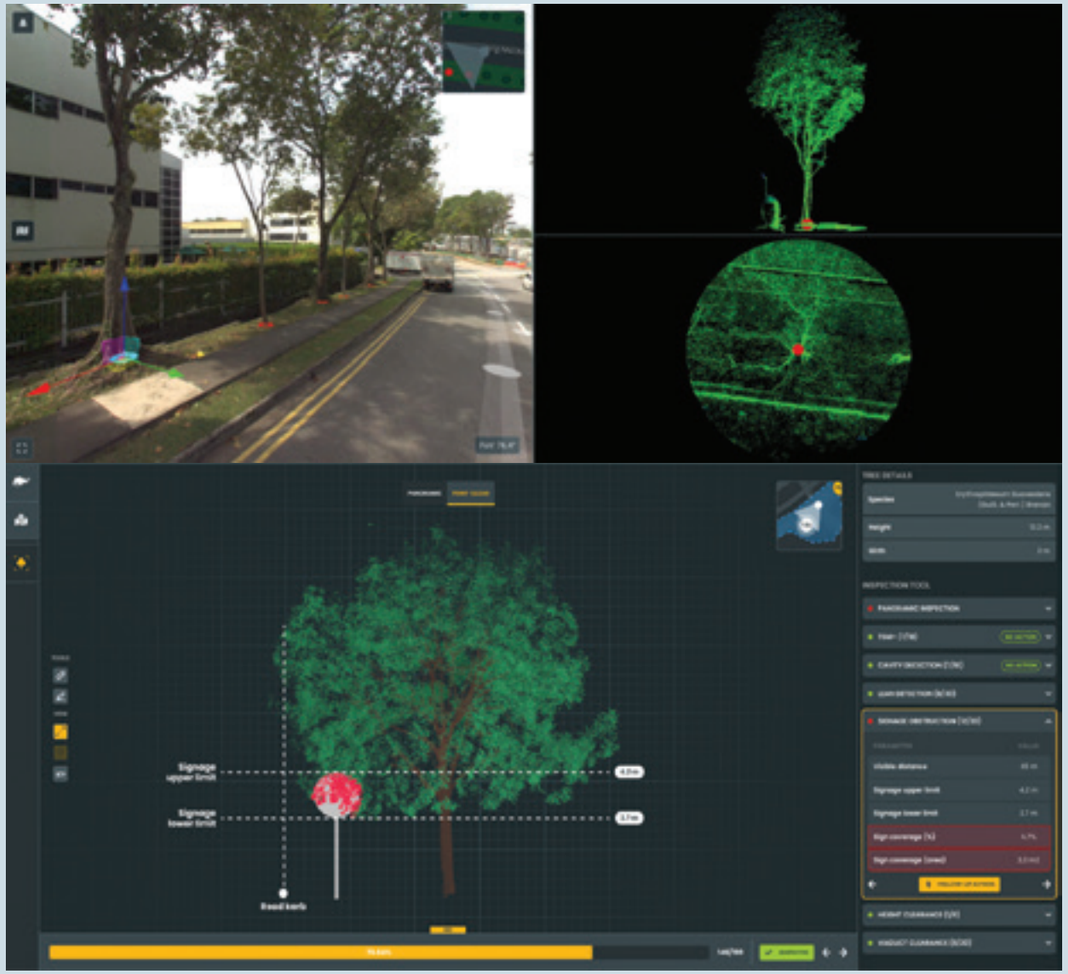
In addition, the development and deployment of technological tools enables NParks to drive greater operational effectiveness and productivity in urban nature management—as greenery and biodiversity become increasingly pervasive in our City in Nature.

View of Singapore skyline from Bukit Timah Nature Reserve.
Image: National Parks Board

Managing Singapore's Urban Trees

Interwoven within Singapore's built environment are an estimated two million urban trees managed by NParks. Under NParks' comprehensive tree management programme, a Geographic Information System-based tree registry system is used to maintain an inventory of Singapore's growing urban tree population, including the trees' individual geolocation and management records.

More recently, a Remote Tree Management System was developed for enhancing accuracy and efficiency in urban tree inventorisation and inspection, where cutting-edge technologies such as mobile laser scanning and panoramic imagery were used to create a comprehensive and representative 3D digital twin of Singapore's urban trees. NParks also leverages other technologies to further its tree management capabilities, such as drones for aerial tree crown inspections, and electronic tilt sensors to monitor the lean of mature trees.



The Remote Tree Management System utilises Light Detection and Ranging (LiDAR) technology to capture dense and accurate point cloud data of trees, which is then processed using machine learning techniques to extract vital information such as tree location, dimensions and branching patterns. This provides representative 3D digital twins of Singapore's urban trees, which can be used for tree inventorisation, virtual inspection and structural modelling, and other applications for tree maintenance, landscape design and city planning.
Image: National Parks Board

A Geographic Information System-based tree registry system is used by field officers for on-site urban tree management.
Image: National Parks Board

Designed for installation on tree trunks, the Tree Tilt Sensor leverages IoT technology to measure tree lean data and transmit alerts to field officers upon detection of tree lean that exceeds a pre-defined threshold. This activates further on-site tree inspection and maintenance.
Image: National Parks Board

Conserving Our Rich Biodiversity

Despite being highly urbanised, Singapore is home to wide-ranging biodiversity residing in terrestrial, coastal and marine habitats. To inform ongoing conservation efforts, NParks leverages a suite of sensor technologies to study and monitor native wildlife populations, such as the use of

- Camera and video traps to survey nocturnal and rare wildlife in Singapore's Nature Reserves and Nature Parks, and to examine the effectiveness of conservation measures
- Satellite tracking to study migratory shorebird movement
- Development of acoustic technologies to survey songbirds and marine megafauna
- New conservation technologies such as the Roadway Animal Detection System and the Forest Fire Detection and Monitoring System, which apply video analytics and machine learning techniques to mitigate vehicular-wildlife collisions and to facilitate early alerts and response to local forest fires respectively.

Camera traps deployed in Singapore's forests enable NParks to monitor the density and distribution of native wildlife populations.
Image: National Parks Board

Satellite tracking technology has revealed that migratory shorebirds wintering in Singapore use both the Central Asian Flyway and the East-Asian Australasian Flyway. This reinforces the significance of Singapore's Sungei Buloh Wetland Reserve as a site of international importance for migratory shorebirds.
Image: National Parks Board

The Roadway Animal Detection System with Advance Warning Signs uses machine learning and a specialised detection system to detect wildlife approaching the road. The system then alerts motorists to slow down through a flashing sign, making road crossings safer for wildlife.
Image: National Parks Board

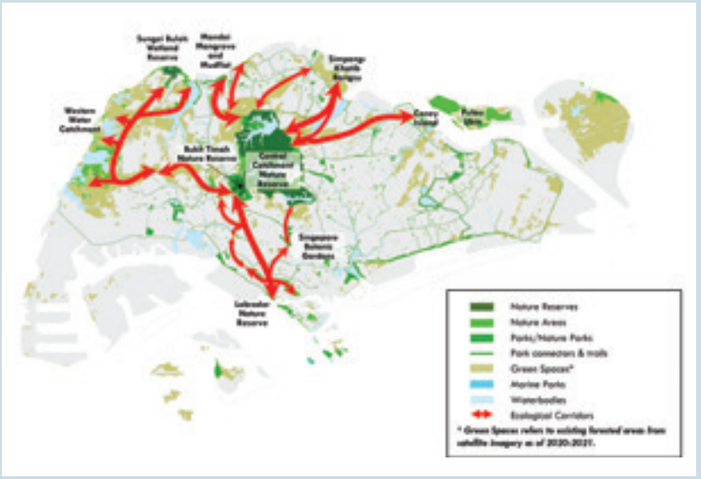
Integrating Nature Conservation and Land Use Planning

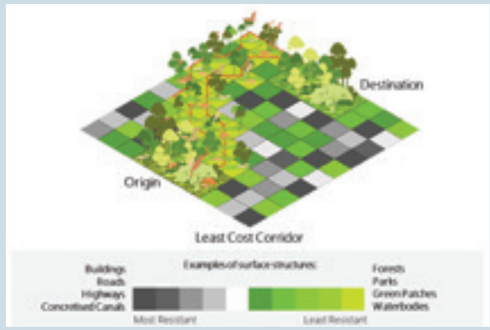
To develop a comprehensive picture of Singapore's island-wide ecosystem and ecological connectivity, NParks led an island-wide Ecological Profiling Exercise (EPE). The EPE utilised a combination of least-resistance pathway and agent-based modelling tools to understand the role of specific sites in providing refugia and ecological connectivity for native biodiversity.

Completed in 2022 in tandem with the Urban Redevelopment Authority's Long Term Plan Review, the EPE facilitated the identification and safeguarding of key ecological corridors between core habitats by establishing plans for Nature Park Networks and Nature Corridors in Singapore's land use plans.

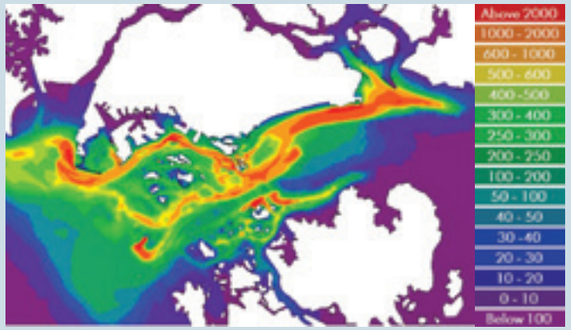
By adopting a holistic and science-based approach, the EPE empowers urban planners to include ecological considerations upfront in the land use planning process, to better balance development with nature conservation.

Map of terrestrial ecological connectivity identified through NParks' Ecological Profiling Exercise.
Image: National Parks Board





Least-resistance pathway modelling for terrestrial habitats identifies the surface structures (e.g., roads, forests, buildings) between core habitats and assigns a numerical value to each structure, with a lower value indicating greater conduciveness for an animal to cross. The least-resistance movement pathway is then established based on the route comprising pixels of the lowest value.
Image: National Parks Board



Agent-based spatial modelling for coastal and marine habitats simulates the movement of large numbers of individual organisms to understand their dispersal pattern, such as coral larvae dispersal following a mass spawning event (map shows predicted cumulative densities of coral larvae within Singapore's coastal waters following a mass coral spawning event in 2013).
Image: National Parks Board

Combatting Illegal Wildlife Trade

On the global front, the use of science and technology has bolstered NParks' efforts to tackle illegal wildlife trade, together with international partners under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

The Centre for Wildlife Forensics was launched by NParks as Singapore's first national facility for wildlife forensics, and has also been recognised as a CITES-registered laboratory. Through collaboration with international experts, the Centre has developed genomic capabilities to sample and identify large volumes of wildlife seizures (e.g., pangolin scales, elephant ivory), to support investigation and enforcement efforts. The Centre also leverages various detection and diagnostic technologies to investigate cases of illegal wildlife trade, including vision-based and AI-assisted tools to identify CITES-listed timber specimens and illegally traded shark and ray species.

Fin Finder is Asia's first mobile application that employs machine learning and artificial intelligence to identify shark and ray species from photos of their fins. Developed through a partnership between NParks, Microsoft and Conservation International, the app helps support worldwide enforcement efforts against illegally traded shark and ray species.
Image: You Wai Hong, Bloom Association

Safeguarding Singapore's Biosecurity

Maintaining high levels of biosecurity is key to NParks' work in safeguarding animal and public health. To strengthen Singapore's biosecurity while reducing stress for pets relocating to Singapore, NParks' Animal & Veterinary Service introduced the use of radio frequency smart collar tags to allow pets imported from lower-risk countries to be quarantined at home and to be monitored closely without separation from their owners.

Remote surveillance and sensor technologies (e.g., drones, closed-circuit television cameras) have also been piloted to strengthen the inspection of imported animal consignments. In addition, NParks has been refining its capabilities in the use of environmental Deoxyribonucleic Acid (eDNA) as a non-invasive approach for the early detection and management of diseases (e.g., in fish and turtles), based on environmental samples such as air or water.

Closed-circuit television cameras with live transmission enable NParks to conduct remote and real-time inspection of imported pig consignments.
Image: National Parks Board

NParks has implemented smart collar tags for animals that are eligible for home quarantine. This also allows animals with pre-existing medical conditions or special medical needs to serve post-arrival quarantine at home. Singapore is one of the first countries to employ the use of such technologies for pet home quarantine.
Image: National Parks Board

Nature for Health and Well-Being

Multi-disciplinary research on the wellness benefits of urban nature has enabled NParks to advance the implementation of landscapes and programming for enhanced public health and well-being. Since 2016, NParks has been incorporating therapeutic gardens into various parks across Singapore, leveraging evidence-based design principles to bring about health and wellness benefits for seniors and other users.

Studies have also indicated that NParks' national horticultural programmes (e.g., community and allotment gardening, therapeutic horticulture, home gardening) contribute towards liveability outcomes such as improved mental well-being and social cohesion, across the general population and for specific community segments. Arising from recent research on how landscape characteristics affect brain activity patterns, NParks has also rolled out design guidelines for contemplative landscapes, which promote the wider implementation of landscapes that enhance mental well-being across Singapore.

Bishan-Ang Mo Kio Park Therapeutic Garden.
Image: National Parks Board

In-situ collection of brain activity data from a participant exposed to a landscape with high contemplative quality. This comprehensive outdoor experimental study employed a multi-modal electroencephalography (EEG) and Functional Near-Infrared Spectroscopy (fNIRS) system for objective assessment of the well-being impacts of green space exposure.
Image: National Parks Board

Research studies conducted in Singapore have found seniors reporting better mental health outcomes after receiving therapeutic horticulture interventions.
Image: National Parks Board

Nature-Based Solutions for Climate Change

NParks is actively driving research to deepen the science behind safeguarding Singapore's natural capital amid climate change, and to advance the implementation of nature-based solutions. Research efforts under NParks' Marine Climate Change Science programme will inform evidence-based strategies to enhance the ecological resilience of Singapore's coastal and marine ecosystems towards climate change impacts (e.g., sea level rise, increasing sea surface temperatures, extreme storm events).

By harnessing multi-disciplinary expertise across government agencies and the research community, the programme will also examine ecological engineering solutions to further protect Singapore's coasts, and blue carbon capture and storage by local habitats. Similarly, NParks is leading parallel research efforts to understand how terrestrial urban greenery and inland blue spaces can be further leveraged as nature-based solutions for climate adaptation.

The Marine Climate Change Science programme will investigate the effectiveness of nature-based solutions such as mangroves, and strategies to strengthen their ecological resilience amid projected climate change.
Image: National Parks Board

The naturalised waterway at Bishan-Ang Mo Kio Park serves as a nature-based solution to build resilience against inland flooding, while providing additional benefits as a biodiversity habitat and recreation area.
Image: National Parks Board

Long-Term Monitoring

NParks' Long-Term Socio-Ecological Research programme consolidates research activities that leverage dedicated long-term study sites, repeated studies, and integrated and interdisciplinary efforts. This allows the programme to examine the long-term impact of Singapore's City in Nature efforts and generate scientific insights to enhance existing strategies.

Efforts under the programme will, for instance, enable monitoring of key ecological processes in Singapore's forests and green spaces. At the same time, the programme will study the values, beliefs, and norms of Singaporeans towards nature, and how Singapore's City in Nature efforts can influence physical, mental, and social well-being outcomes.

The programme also includes a Long-Term Forest Ecological Monitoring plot network in the Central Catchment Nature Reserve, where monitoring studies will improve our understanding of historical changes in Singapore's forests, and inform future efforts to support forest ecosystem resilience.

Tree and vegetation survey in a Long-Term Forest Ecological Monitoring plot within the Central Catchment Nature Reserve.
Image: Teo Jinying

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