

Foresight brief series

Creating smarter cities



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Foresight brief series

Creating smarter cities

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Entrepreneurship Alliance for
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under the Telecommunication
Development Bureau



Acknowledgments

This report is part of the International Telecommunication Union (ITU) Foresight Brief Series, a product of the ITU Telecommunication Development Bureau (BDT) under the Innovation and Entrepreneurship Alliance for Digital Development (the Alliance) initiative. It was led and written by strategic foresight expert Elaine France under the supervision of the Digital Transformation Lab, a core component of the Alliance.

The report contributes to the ITU Development Sector (ITU-D) priority of digital transformation and supports the efforts of Member States to integrate innovation into their national development agendas. It could not have been completed without the support of the Digital Innovation Board and their focal points, and the Expert Network of the Alliance, whose valuable feedback and contributions greatly enriched the analysis presented.

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Foreword



Cities lie at the heart of human progress. They are engines of economic opportunity and hubs of cultural exchange and innovation that shape the daily lives of people in an increasingly interconnected world.

With rapid urbanization, technological disruption, and demographic change, there is an urgent need for cities to become smarter, more inclusive, and more resilient. Smart cities are not simply about adopting advanced technologies – they are transforming how people live, move, govern, and collaborate. Smart cities are shaping our quality of life.

This foresight brief invites us to explore the various trajectories and potential futures of urban development through the lens of digital transformation, innovation, and human-centred design. As a product of the BDT Innovation and Entrepreneurship Alliance for Digital Development initiative, this series envisages equitable futures and aims to inspire countries to shape digital ecosystems that can thrive in an ever-evolving world. By examining long-term trends, emerging technologies, and shifting social dynamics, this foresight brief challenges us to rethink how urban systems can deliver better services, greater sustainability, and improved quality of life for all communities.

From mobility and public services to energy systems and urban planning, technological developments such as artificial intelligence, advanced connectivity, data-driven governance, and green technologies are reshaping how cities function. However, creating smarter cities is not solely a technological endeavour. It also requires inclusive governance, strong public-private collaboration, sustainable financing models, and trusted mechanisms for managing data and digital rights. Above all, it requires ensuring that the benefits of smart city development reach everyone, especially those communities in underserved areas and the vulnerable.

Strategic foresight provides a powerful tool to navigate this complexity. By exploring alternative future scenarios, policy-makers and other ecosystem stakeholders can better anticipate risks, seize emerging opportunities, and design strategies that remain agile in a rapidly evolving urban landscape. Through participatory engagement, strategic foresight strengthens collective capacity to co-create smarter cities that are not only technologically advanced but also socially inclusive, environmentally sustainable, and grounded in the everyday realities of residents.

The ITU Telecommunication Development Bureau remains committed to supporting its membership on this transformative journey. I look forward to seeing how this report will inform national urban strategies, inspire bold cross-sectoral action, and help mobilize new partnerships. We stand ready to work with all stakeholders to translate the insights presented here into practice and help build cities that are innovative, sustainable, trusted, and future-ready.

A handwritten signature in black ink, reading "Dr. Cosmas Luckyson Zavazava".

Dr. Cosmas Luckyson Zavazava
Director, Telecommunication Development Bureau (BDT)
International Telecommunication Union

Executive summary

Rapid urbanization, climate stress, demographic shifts, and technological disruption are converging on an unprecedented scale, especially in developing regions. Smart cities and smart communities offer a pathway to more liveable, regenerative, and equitable futures by harnessing digital innovation to improve quality of life (QoL). However, this potential impact continues to be limited by fragmented smart city pilot projects, weak governance, uneven connectivity, and widening digital divides, which risk deepening existing inequalities.

Drawing on extensive analysis, this foresight brief highlights signals and trends that are reshaping urban futures. These signals and trends range from youth-driven digital expectations, and citizen science and participatory platforms, to the expansion of 5G, the Internet of things (IoT), digital twins, and frugal mobile-first innovation initiatives. New climate and green-finance models, intensifying environmental shocks, the alignment of smart city missions with digital-green-energy strategies, evolving data protection and cybersecurity laws, and rising concerns about surveillance, inclusion, accessibility, and e-waste further underscore the complexity of the urban futures landscape.

From these signals and trends, four mega drivers emerge as central forces shaping smart sustainable cities and communities:

- Policy alignment reflects integrated visions, QoL-focused strategies, and evolving privacy and cybersecurity frameworks.
- Operational capacity relates to the maturity of digital infrastructure, emerging technology adoption, and interoperable open data systems.
- Strategic support encompasses governance, accountability, partnerships, and investment.
- Ecosystem capacity captures the dynamism of entrepreneurship, the depth of citizen and community participation, the rise of climate resilience measures, and the expansion of capacity-building and lifelong learning.

Together, these four mega drivers reveal opportunities and risks that define the main trajectories for future urban systems.

The interaction of these drivers informed the development of a series of contrasting scenarios, some optimistic, some pessimistic, and some business-as-usual, regarding the future of smart cities and smart communities. From this series of scenarios, four optimistic transformational pathways were shortlisted and examined in depth to identify a desired future scenario. Of these, the 'open everything' scenario clearly stands out as offering a future in which robust governance, strong digital infrastructure, interoperability, and empowered ecosystems converge to facilitate and drive inclusive digital-green innovation that tangibly improves QoL for all citizens. This 'open everything' scenario aligns most closely with the objectives of the study as it encompasses participatory governance, resilient and affordable infrastructure, local capacity development, sustainable systems, and technology-enabled transformation. The 'open everything' scenario positions smart sustainable cities and communities as engines of innovation and inclusion, that are grounded in human-centred design, and rooted in experience.

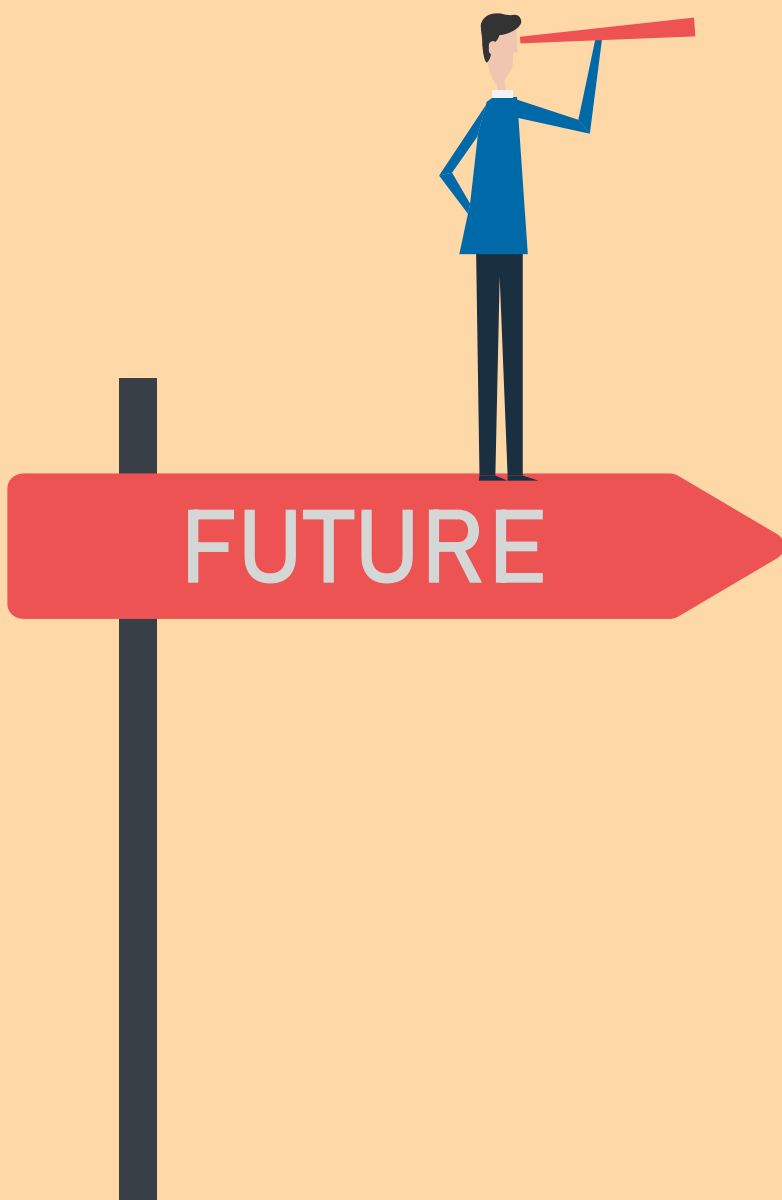
To realize this vision, close systemic gaps, and strengthen the digital innovation ecosystem for future-ready cities and communities, this foresight brief sets out a coherent roadmap that proposes:

- embedding QoL, climate resilience, interoperability, cybersecurity, and adaptive regulation across public sector planning and policy-making;
- expanding institutional data and digital skills, shared infrastructure, and talent pipelines;
- advancing mobile-first inclusion, using public procurement to stimulate demand-side innovation, and building value chains across priority sectors;
- generating actionable insights through interoperable data systems, skills and artificial intelligence (AI) impact assessments, and the use of digital green twins;
- strengthening real-time open data platforms and peer-learning networks; and
- aligning roles, capital, and oversight through coordinated governance, participatory mechanisms and structured investment frameworks.

Together, these actions can provide a unified pathway for inclusive, resilient, and scalable smart city implementation.

Global examples demonstrate that this ambition is achievable. The ‘Sponge City’ approach taken in the People's Republic of China, and the urban greening approach in Copenhagen, highlight how climate-resilient design can be embedded in city planning. The open-data reforms introduced in Mexico City, and the digital governance framework initiated in the Republic of Estonia, also demonstrate how transparency and interoperability can transform public services.

Ultimately, cities that prioritize openness, trust, and inclusivity are best placed to harness digital transformation for societal benefit. With strategic foresight, inclusive ecosystems, and a QoL-first mindset, today’s smart city pilot projects can evolve into vibrant, human-centred urban futures that are resilient, equitable, and truly transformative.



1 Introduction to futures thinking and strategic foresight

1.1 Futures thinking and strategic foresight

An approach to navigate uncertainty and shape desired futures

Futures thinking is the practice of exploring how different outcomes might unfold by identifying trends, emerging issues, and critical uncertainties, challenging linear thinking and imagining a range of plausible futures rather than relying solely on past patterns. Strategic foresight is the structured application of this approach to inform present-day decisions. It blends trend analysis with creative exploration, helping us prepare for multiple possibilities, anticipate disruptions, and build more resilient systems.

Together, futures thinking and strategic foresight provide a powerful toolkit for navigating change. Instead of predicting a single outcome, they prompt questions about what could happen, what ecosystems should prepare for, and what kind of future is desired. In doing so, these approaches shift the focus from reacting to events to proactively engaging with the forces shaping tomorrow.



Strategic foresight provides pathways to act intentionally in uncertain environments, equipping institutions, governments, and communities with the agility to adapt and the imagination to innovate. In essence, it is about expanding the field of vision to move forward with purpose, even when the road ahead is unclear.

1.2 The importance of futures thinking

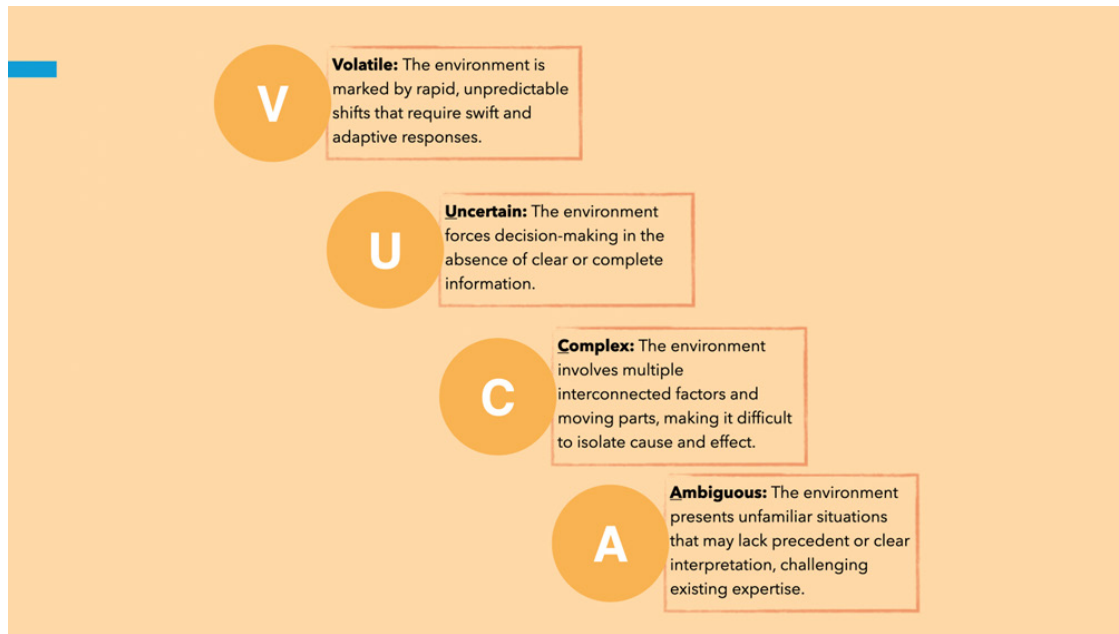
Addressing complexity and disruption in a volatile, digital world: The need for futures thinking

In an era of accelerating technological advancement, climate uncertainty, demographic shifts, and geopolitical turbulence, new ways of thinking are required to confront a volatile, uncertain, complex, and ambiguous (VUCA) environment.

Futures thinking is essential because it shifts the focus from short-term fixes to long-term preparedness, enabling policy-makers, innovators, and communities to anticipate disruptions and take advantage of emerging opportunities. In doing so, futures thinking fosters a mindset of resilience and adaptability, as it is about shaping the desired future and not just focused

on survival. It reflects the need to look beyond immediate pressures and attempts to answer deeper questions about the kind of society being built, who benefits from it, and who could be left behind. In answering these questions, futures thinking becomes an essential compass for navigating uncertainty and an invaluable tool for building more inclusive, sustainable, and forward-looking systems.

Figure 1: VUCA



Source: ITU

Utilizing futures thinking to improve long-term planning

Long-term planning often struggles to keep pace with the rate of change in the modern world. Futures thinking reinvigorates the planning process by anchoring it in possibility rather than assumption. Through structured scenario development, horizon scanning, and the identification of key drivers of change, futures thinking challenges existing mental models and opens new strategic options.

Futures thinking allows organizations and governments to test the resilience of their plans under multiple future conditions. It brings clarity to complex environments by highlighting not just what might happen, but what could be done in response. As a result, decision-makers can allocate resources more effectively, prioritize innovation, and align initiatives with emerging needs.

By integrating futures thinking, planning becomes a dynamic, iterative process that is better equipped to handle shocks, adapt to transitions, and pursue transformative outcomes. Ultimately, it strengthens the ability to act with foresight today to ensure a more equitable tomorrow.

1.3 Introducing the foresight brief series

Helping stakeholders stay ahead of the curve

The foresight brief series is a collection of research reports designed to help ITU Members navigate the uncertainties of an increasingly digital future. It is being developed by the

Innovation and Entrepreneurship Alliance for Digital Development (the Alliance) under the ITU Telecommunication Development Bureau.

Using structured strategic-foresight methodologies and presenting the findings in an accessible format, the series enables stakeholders to stay ahead of the curve by identifying weak signals, analysing trends, and exploring emerging disruptions that may reshape key sectors or focus areas. The briefs present scenario-based insights that impel policy-makers and ecosystem actors to consider multiple plausible futures and design strategies that are resilient, inclusive, and future-ready.

Rather than predicting the future, the series encourages a shift from short-term responses to long-term preparedness. By curating actionable futures intelligence, it empowers Members to make informed decisions in a rapidly evolving environment. The briefs are not meant to be conclusions, but to act as starting points for continued dialogue, collaboration, and development among stakeholders.

In line with these objectives, the briefs provide instructions for stakeholders seeking to move beyond fragmented initiatives towards an integrated vision supported by practical next steps.

Specifically, the briefs:

- illuminate emerging trajectories by mapping the structural trends, weak signals, and wildcard events shaping the topic in focus, informed by desktop research, stakeholder surveys, and expert interviews;
- define desirable futures using scenario thinking to articulate concrete visions for the future that advance the strategic objectives of the brief, while also examining alternative, less desirable, and even wholly undesirable pathways;
- develop strategic options by identifying policy levers, capacity-building measures, and ecosystem-building actions that support progress towards the desired future; and
- equip decision-makers by offering public and private stakeholders, financiers, researchers, innovators, and entrepreneurial support systems a clear roadmap for translating foresight conclusions into coordinated measures.

1.4 The ITU approach to strategic foresight

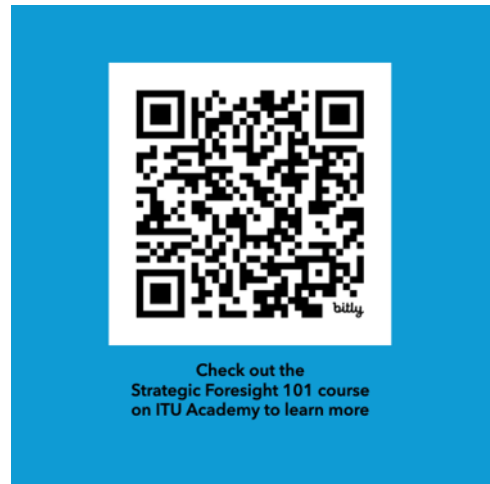
A structured and collaborative methodology to anticipate change

The strategic foresight methodology provides a structured yet flexible approach to help stakeholders anticipate change, navigate uncertainty, and accelerate digital transformation. By integrating systems thinking, design thinking, and futures thinking, the ITU ecosystem-based approach fosters collaboration and co-creation, while remaining aligned with national, regional, and global development goals. This empowers countries and communities to shape inclusive, resilient, and future-ready societies.

The methodology underpinning this foresight brief is drawn from the ITU Playbook on Strategic Foresight, a step-by-step, tool-based guide. The methodology aims to democratize foresight knowledge and practice, making these powerful tools accessible to a wide range of actors.

The basics of this methodology, for a foundational understanding of strategic foresight, are also outlined in a self-paced and free online course titled 'Strategic Foresight 101, available on ITU Academy.

The foresight journey unfolds across several stages. It begins with framing and scanning more than 200 environmental signals and trends to identify drivers of change through desktop research, surveys, interviews with subject-matter experts, and co-creation workshops with ecosystem stakeholders to ensure that diverse perspectives are heard and incorporated. These drivers are then analysed and mapped to assess their potential impact and uncertainty, laying the groundwork for exploring future possibilities. By pairing impactful and uncertain drivers, plausible scenarios are generated to highlight emerging opportunities and challenges. From these, a preferred scenario is chosen and shaped through the creation of a forward-looking action roadmap, which is further reinforced by mechanisms that help keep recommendations responsive, relevant, and managed over time.



The findings of this brief have been validated by the Members of the Innovation Alliance Strategic Foresight Thematic Group, as well as the Digital Innovation Board of the Alliance, to ensure that the findings are rigorous, future-aligned, and actionable for stakeholders.

This ecosystem-driven methodology reflects the principles of the ITU innovation framework, empowering countries and communities to develop inclusive, resilient, and future-ready societies.

Readers can explore other publications from the foresight brief series at bit.ly/itustrategiforesight.

1.5 Objectives of the 'Creating smarter cities' foresight brief

Unlocking the potential of smart cities and communities

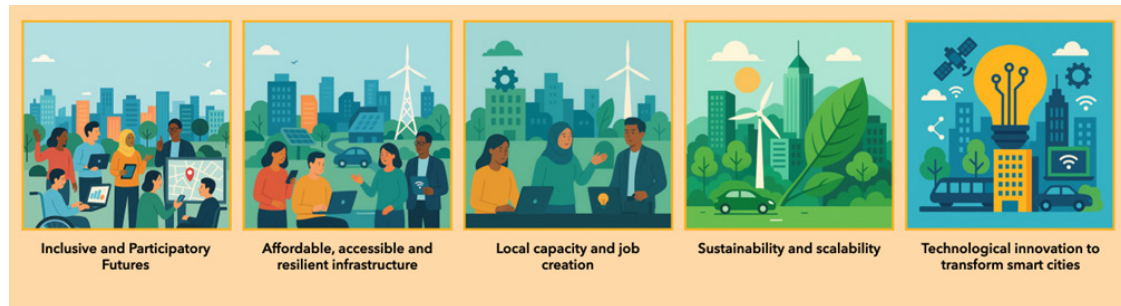
It is projected that there will be 43 megacities by 2030, meaning cities with over 10 million inhabitants, most of which will be in developing countries. It is also expected that 68 per cent of the global population, or some 2.5 billion people, will live in cities by 2050 (Department of Economic and Social Affairs, 2018). As cities already consume over 75 per cent of global energy and contribute significantly to CO₂ emissions, the digital transformation of both urban and rural communities is now central to global sustainability requirements.

The future of smart cities and smart communities, particularly in developing regions, lies in enhancing quality of life while ensuring resource sustainability within planetary boundaries. As rural-urban migration accelerates, it is clear that developing innovation in smart cities alone is insufficient, and that extending innovation to smart communities is vital in order to balance urban growth with rural inclusion.

Smart cities harness advanced technologies, including artificial intelligence (AI), the Internet of things (IoT), blockchain, and real-time big data analysis, to optimize infrastructure, streamline public services, foster regeneration, deliver financial efficiencies, and increase the overall well-being of citizens. However, technology is not an end in itself, rather it is a critical tool for

advancing inclusive, resilient, and sustainable development. This foresight brief therefore calls for a paradigm shift, moving from using technology solely for increased efficiency, to harnessing technology to promote the well-being of people and the planet.

Figure 2: Interlinked objectives intended to shape development of smart cities and communities



Source ITU

Five interlinked objectives will shape the pathway forward. They are:

- inclusive and participatory futures, which ensure that all citizens have a voice in shaping the future of their cities through inclusive governance and digital tools;
- affordable, accessible, and resilient infrastructure, which entails building smart systems that are cost-effective, universally accessible, and adaptable to future shocks;
- local capacity and job creation, which empowers communities by fostering digital green and entrepreneurship skills for innovation, as well as new employment opportunities in smart city ecosystems;
- sustainability and scalability, which promotes environmentally responsible solutions that can be expanded and replicated across diverse contexts; and
- technological innovation to transform smart cities, which advances the research, development, and adoption of emerging technologies to enhance service delivery, expand opportunities, and improve citizen QoL.

1.6 The case for sustainable smart cities

From smart city pilot projects to people-centred, sustainable smart communities

A smart sustainable city is an urban environment that uses advanced technologies, primarily AI, IoT, blockchain, and real-time big data collection and analysis, to optimize public infrastructure, enhance public services, support sustainability and regeneration initiatives, deliver financial efficiencies, and improve the QoL of all of its citizens. The overall goal of digital innovation in a smart city, is to be responsive, efficient, and sustainable by leveraging information and communication technologies (ICTs). This involves adapting in real-time in ways that increase the well-being of citizens socially, culturally, economically, and environmentally, both in the present and for future generations.

As more people continue to gravitate to cities, many end up living in informal settlements or shanty towns. In 2022, 1.1 billion people or 24.8 per cent of the global urban population, were living in informal settlements. Parts of the Asia and Africa regions account for over 85 per cent of that figure. Without intervention, up to 2 billion more people could be living in informal settlements within 30 years (UN-Habitat, 2022). Furthermore, cities currently consume over

75 per cent of global energy and contribute significantly to CO₂ emissions, making urban transformation central to achieving sustainability.

Traditional city infrastructures can no longer keep pace with the demands of growing populations. Historically, many smart city projects have stagnated after the pilot stage due to lack of collaboration among stakeholders in recognizing public needs on a city-wide scale, combined with low levels of citizen acceptance, which prevents scalability (Bundgaard and Borrás, 2021). Smart city initiatives must therefore be financially sustainable, moving beyond short-lived pilots to improve living conditions, livelihoods, and public services. Consciously moving away from stand-alone to multi-city strategies, and joining up previously disparate projects into coordinated constellations, creates new pathways forward.

In developed countries, smart city initiatives often focus on upgrading infrastructure, such as improving energy efficiency and mobility. In contrast, developing countries face the structural challenges of rapid urbanization, informal housing, and limited resources. However, these contexts also present opportunities to bypass legacy systems by using technology to extend essential services such as healthcare and education more equitably. Furthermore, there is the potential to create the conditions where developing countries are not merely technology users and consumers, but can also develop the resources to become technology producers themselves, thereby optimizing South-South cooperation.

Narratives must extend beyond infrastructure to advancing the social and economic well-being of current and future generations (UN-Habitat, 2025; UN Global Digital Compact). While smart cities must prioritize safety, resilience, inclusivity and job creation, particularly in developing regions, it is crucial that the transition to 'smartification' does not erase cultural heritage or biocultural diversity (Department of Economic and Social Affairs, 2018; UN-Habitat, 2023).

Equitable smart communities should be shaped by employing people-centric approaches, especially for the elderly and for persons with disabilities, to reduce wait times, expand employment opportunities, enable transparent governance, and increase access, while also preventing benefits from becoming concentrated only in urban centres for a small minority.

The urban technology market is growing rapidly and with an annual growth of over 25 per cent, is expected to exceed USD 1.4 trillion by 2030 (Zelt *et al*, 2023). In order to scale sustainably, innovation requires cybersecurity, ethical AI, interoperability, and integrated policies that prioritize QoL (UN-Habitat, 2024; World Urban Forum). However, regulatory gaps persist, with only 20 per cent of smart cities having data protection laws, and just 36 per cent having adopted ethical AI frameworks (UN-Habitat, 2025).

1.7 Bridging the digital divide

Closing digital gaps to unlock meaningful smart city participation

Bridging the digital divide is critical to enabling citizens to use and participate in their smart city. However, 2.6 billion people still lack affordable Internet access or digital skills, and 39 per cent of those with access do not use the Internet (ITU, 2024; UN-Habitat, 2024). Collaboration between city and community leaders is required to build smart sustainable communities that are both global and local, and which are anchored in inclusive governance, innovation ecosystems, and citizen participation.

Strategic foresight, inclusive policies, and responsible digital transformation are essential to ensure that smart cities are not just technologically advanced, but also liveable, regenerative, equitable, resilient, and sustainable. The approach to developing each smart city should be tailored to its unique characteristics and priorities, rather than simply adopting a one-size fits all approach.



Through collective action and investment, including in entrepreneurial ecosystems, smart sustainable cities can become drivers of innovation, sustainability, and citizen well-being for generations to come (World Urban Forum).



2 Sensing in a volatile, uncertain, complex, and ambiguous world

Identifying signals and emerging trends

This section presents the first step in the strategic foresight process: identifying early signals and emerging trends in the external environment. It begins with scanning the horizon across diverse domains (e.g. social, technological, economic, environmental, political, legal, and ethical) to identify patterns of change and map the underlying forces shaping the future.

This exploratory phase lays the foundation for the foresight process by framing the scope of an inquiry, revealing cross-cutting influences, and highlighting the dominant trends and marginal signals that may point to emerging disruption.

2.1 Exploring signals of change for a smarter cities landscape

Signals are observable events, behaviours, or developments that indicate potential change. While individually they may appear incremental or isolated, collectively they provide early insight into how systems are evolving and where transformation may be gathering momentum. The following signals, mapped across social, technological, economic, environmental, political, legal, and ethical dimensions, highlight patterns that can shape the future landscape of the sector being analysed.

2.1.1 Evolving social landscape

Social dynamics, such as demographics, culture, education, and well-being play a key role in shaping smart sustainable cities, particularly in developing countries.

There has been a clear shift in rationale from technology for its own sake, to technology that enhances the QoL and well-being of citizens. This shift is supported by global guidelines, which emphasize the importance of building people-centred smart sustainable cities based on integrated regional, national, and local visions and strategies that are aligned with sustainability priorities such as water, energy, and waste management (UN-Habitat, 2025).



For citizens, this translates into greater liveability, with easier access to education, healthcare, culture, mobility, and economic opportunities, as well as the ability to escape overcrowded urban environments (Global Liveability Index, 2025). Cultural acceptance of technology is rising, and in many developing countries, the young population are driving the expectation of digital-by-default public services.

It is estimated that 2.5 billion people will live in cities, particularly in the Africa and Asia regions, by 2050 (Department of Economic and Social Affairs, 2018). The number of informal and shanty settlements is therefore projected to increase, as people with limited resources migrate to cities in search of employment and better life prospects (GSM Association; UNSD, 2025).

In order to avoid creating elite smart-city enclaves, it is essential that all citizens, especially underserved and informal populations, have digital access and the necessary digital skills to navigate these smart cities geographically, economically, and democratically (Toronto, 2018).

Although Internet usage has doubled between 2015 and 2025, limited affordable digital access continues to contribute to low social media penetration in developing countries (Data Portal, 2025). A number of developing countries have initiated legal actions against global social media companies for breaches of data privacy, unethical practices, surveillance, and unauthorized data sharing. Developed countries have pursued similar legal cases related to the use of citizens' data for AI training (Bala-Gbogbo and Dzirutwe, 2024). While attitudes towards the collection of personal data in smart cities remain mixed, data-driven solutions supporting mobility, safety, and crime management tend to receive positive support (International Institute for Management Development, 2024; Observatory of Public Sector Innovation, 2022). However, concerns about privacy and trust are growing (Stouhi, 2022).

Co-designing smart neighbourhoods and cities, with communities using participatory futures methods and 3D and augmented-reality tools, has been shown to increase trust, ownership and relevance in urban planning (Naidoo, 2025; Ranasinghe *et al*, 2025). Participatory e-government platforms, ranging from city kiosks (city kiosks are public digital terminals installed in urban spaces that allow residents to access government services and information, or to participate in civic activities) to digital decision-making systems, are increasingly facilitating transparent and democratic contributions to urban policy planning and decision-making processes (Decidim Barcelona).

Open-source sensor kits connected to the Internet of things (IoT) enable citizens of all ages to become 'citizen scientists', collecting, analysing, and sharing data to improve city management, inform policy, and strengthen urban well-being. This approach is particularly impactful in integrating formal and informal settlements, through participatory mobile phone mapping, and through localized environmental monitoring projects using open-source technologies (Digital Matatus; Arduino).

Community apps are increasingly being used to engage residents, while neighbourhood apps are being adopted to strengthen social connections and community cohesion fostering a genuine sense of community that goes beyond logistics (Atma Connect).

2.1.2 Evolving technological landscape

Technological trends point to the expansion of 5G networks as critical infrastructure supporting connected IoT devices and enabling the advancement of smart sustainable cities (Khalifeh *et al*, 2025). This facilitates the increasing use of open-source technologies and open data.

The large-scale deployment of sensors across cities to collect data requires robust data collection methods and platforms capable of real-time, AI-driven analysis and automation. This is being achieved through modular solutions that also support cost-effective continuity and scalability. Urban operating system (UOS) interoperability remains essential across sensors, wireless systems, and analytics platforms, with front-end approaches addressing data interoperability challenges (OECD, 2023; Jeong *et al*, 2020; European Commission, 2018; X2MConnect). Digital integration as a service, which integrates digital systems, applications, and data sources without requiring in-house hardware or in-depth technical expertise, is emerging as a solution to rapidly evolving integration needs (Gigaspace).

Low-cost and frugal innovation strategies, enable national governments and city councils to initiate smart city implementations through mobile-first, low-bandwidth approaches that reduce retrofitting costs (Ebolor, 2023; Digital India; WEF, 2022; GSM Association). These inexpensive, mobile-first, and low-bandwidth strategies, support inclusion and enable residents without formal addresses who live in informal settlements or in scattered urban areas, to access public services (India in 100 Cities, 2015; UNSD, 2025).

Cities are focusing on smart public services to increase efficiency, reduce waste, and lower costs, particularly with regard water, energy, and waste management. 5G-enabled mobility projects support autonomous transport, electric buses, and real-time operations. Mobility as a service is evolving through the use of AI and automation to manage public transport, reduce congestion, and lower greenhouse gas emissions (Ho and Tirachini, 2024). AI-powered cameras integrated with intelligent command centres are enhancing public safety and traffic management (Times of India, 2025). Cities are also deploying AI-driven urban planning and scenario modelling for applications including air-quality mapping, flood prediction, and green-space optimization.

City as a service strategies can transform entire cities into testing grounds for innovative services (OECD, 2023). Global partnerships are increasingly offering normative guidance and frameworks for prototyping city solutions in virtual environments (ITU). Cities are developing test platforms to sandbox and prototype smart infrastructure using 5G, long range wide area networks (LoRaWAN), edge computing, cloud systems, and multi-protocol sensor networks, including large-scale IoT testbeds that enable real-world experimentation (Rito *et al*, 2022; Aveiro; Sanchez *et al*, 2024). Digital twin cities are evolving into 'green digital twin cities' as virtual environments in which sustainability solutions can be tested before implementation (UNDP, 2025). Green digital twin cities support innovation planning and participatory engagement, with generative AI increasingly incorporated to automate urban design and optimize infrastructure (3DCity; EU Urban Mobility Observatory, 2024; Xu *et al*, 2024). Smart infrastructure monitoring uses sensors and AI to assess the condition of roads, bridges, and other public assets in real time (Georgia Tech, 2024). Using inexpensive sensors and mobile phones, vast increases in open data sets are supporting innovation (Sense My City). APIs released by city authorities enable programmatic access to city data for community and business use (Smart Cities Library). Meanwhile, citizen-led mobile mapping and geospatial analysis, using tools such as Google Earth and satellite data, are enabling targeted infrastructure investment (Smart City Research Centre; Wired, 2008).

Traditional energy grids are being reimagined, with open-source technology and data, enabling community-owned microgrids, supported by blockchain, to explore decentralized energy trading (Tando, 2025). Super-app integration is being employed to consolidate multiple public and private services onto single mobile platforms, thereby enhancing citizen engagement (Liew, 2021). With all of this new technology embedded into the urban fabric, proactive end-of-life

management strategies for sensor e-waste are now also being implemented in smart cities (Eurocities, 2025; Smart Cities World).

2.1.3 Evolving economic landscape

Economic dynamics are transforming how smart sustainable cities are designed, operated and financed. Governments have learned from early smart city initiatives that targeted, government-led funding which reduces project risk is more attractive to investors (World Bank, 2019). With varied combinations of federal, philanthropic, private and loan-based finance expanding, the green and climate bonds market is steadily growing, and the 'New Collective Quantified Goal' on just energy transition is also shaping emerging climate finance trends (Buchner *et al*, 2024; Climate Bonds, 2024; WEF, 2024). Investment in water-technology and clean-technology is also rising steadily (WEF, 2023). Meanwhile, foreign institutional investment in the Africa and Asia regions is exerting a soft power, and privately funded 'startup cities' are emerging to fuel innovation that aligns with local culture (Forbes, 2020; AP News, 2025; de Vergès, 2024).

Developing countries face economic challenges and resource constraints, including limited fiscal capacity, infrastructure gaps, and uneven access to technology. Smart city initiatives are increasingly leveraging technology to transform education, generate employment, and develop future-oriented industries, helping citizens access public and private services. Expanding smart city development beyond major urban centres supports more equitable regional growth. Technology is driving this transformation by enabling productivity, connectivity, entrepreneurial activity, and job creation in sectors such as data analytics, sensor manufacturing, urban technology, clean energy, and digital services (Younite.ai, 2025; India Brand Equity Foundation, 2025; Conceição, 2025; Waqar *et al*, 2025).

5G, IoT, AI and data management technologies are driving efficiency and reducing costs, while also enabling entrepreneurship, talent development, and job growth. Innovation hubs and technology parks help to position cities as incubators, consolidating fragmented support systems (Appio, 2019; Mirrakh). Meanwhile small and medium enterprises (SMEs) are increasingly delivering smart solutions in the mobility, energy, and fintech sectors. Special economic zones (SEZs) attract investment and ecosystem actors, facilitating the development of startups and SMEs through subsidized support (SmartCitiesWorld, 2022). Fintech is facilitating instant payment systems, scaling digital transactions, and accelerating e-commerce growth.

International partnerships for smart city development facilitate the exchange of strategic expertise and investment, while cross-border multi-stakeholder innovation challenges are targeting so called "wicked problems" (World Urban Forum, 2024). These are complex, interconnected challenges that are difficult or impossible to solve with a single, straightforward solution because they involve multiple stakeholders, competing priorities, and changing conditions. (The Economic Times, 2025). Technology startups and SMEs are beginning to leverage their intellectual property (IP) as legitimate financial collateral, attracting greater investment and boosting innovation.

Startups are harvesting open data to develop digital green solutions, and there has been growth in clean technologies including energy, water, air, mobility, and waste technologies, as well as in 'x-as-a-service' models (Department of Economic and Social Affairs, 2023; WEF, 2023; StartUs Insights, 2025). Demand for hyper-local, app-enabled services is rising, with startups shifting from point solutions to platforms and API-driven economies. New business models are emerging as companies offer data-as-a-service to governments and businesses (Evreka.

co). Growth is also evident in smart security solutions crucial for maintaining cybersecurity (Novinson, 2025). Capacity building remains vital for startups, SMEs, and public and private teams, as jobs in IT, data, and urban technology expand (Pissareva, 2025; CEDEFOP, 2022; Carvalho, 2024). Educational programmes in smart cities are being adapted to prepare the workforce for future industries, with AI literacy initiatives and training pipelines targeting young people and underserved communities (EU Digital Skills and Jobs Platform, 2026). Skills at the intersection of planning, infrastructure, and nature-based solutions are particularly in demand (World Bank, 2022).

Procurement reforms emphasize outcome-based approaches and open standards to scale solutions. Public-private partnerships (PPPs) remain key, but governments need stronger contracting capabilities to manage x-as-a-service models and avoid vendor lock-in (World Bank; Goldsmith and Gardner, 2023; ITU Academy; UN-Habitat, 2022). Cities are increasingly embedding green and inclusion target provisions to include local SMEs, and investment recovery measures (Monteiro, 2024; European Commission, 2022). Evolving data governance frameworks protect privacy in private-sector contracts, and some cities are now monetizing open data sets (OECD, 2023; LNK NYC).

2.1.4 Evolving environmental landscapes

As planetary sustainability boundaries continue to be exceeded, environmental factors are increasingly shaping smart city design to ensure a focus on quality of life and the well-being of citizens (Rockström *et al*, 2023).

Climate change and biodiversity loss are intensifying environmental shocks, including extreme weather, resource scarcity, and disaster events, particularly in urban areas. Cities are warming faster than rural regions, driven by climate change, urban expansion, and the urban heat island effect (Phys.org, 2022). Most megacities already show accelerated warming (PubMed, 2018). Between 1983 and 2016, global urban exposure to extreme heat increased by 200 per cent, disproportionately affecting the urban poor (Tuholske, 2021). Rising daytime heat stress is pushing increased night-time activity in public spaces, yet night-time temperatures are also rising, and natural overnight cooling has fallen (Earth.org, 2024; Zhang *et al*, 2022). In order to counteract the effects of urban heat islands, cities are implementing various adaptation measures to safeguard citizens (United States Environmental Protection Agency; World Resources Institute, 2025; Priya and Senthil, 2025). Planners are using low-cost sensors and AI-based monitoring tools to collect blue/green data which is used to guide urban greening initiatives and track vegetation coverage over time in order to target investment with greater efficiency (Lawrence, 2025).

Global smart city guidelines specifically emphasize the importance of embedding sustainability solutions for risk reduction and climate resilience (UN-Habitat, 2025). The implementation of Earth law further accelerates the development and application of climate and clean-tech solutions (Earth Law Centre; WEF, 2023; EY, 2023). Cities are deploying smart solar microgrids to enable decentralized energy management and local energy generation, while localized energy data collection is strengthening community energy ownership models. Smart energy meters and adaptive street lighting are increasing per capita energy efficiency and accelerating the shift towards renewable energy (ytl-e.com, 2024). Real-time pollution monitoring is now being used for air-quality indices (Clean Air Task Force, 2024). Smart transport systems are reducing greenhouse gas (GHG) emissions, while sensor-enabled air-quality monitoring supports city management decision-making on mobility and industrial activity (Wu *et al*, 2025; Hassani *et al*,

2024). The integration of electric buses, e-bikes, and sustainable mobility fleets showcases the adoption of low-emission transport solutions, while the expansion of electric vehicle charging networks continues to drive the transition from combustion to electric vehicles (Times of India, 2025).

Water management strategies aim to address the tension between digital transformation and the high water requirements of data centre cooling systems. Smart water-management tools are becoming increasingly efficient at conserving scarce resources, while urban forestry, vertical farms, smart irrigation, and green traffic parks can all enhance water ecosystem health, water quality, and access to drinking water (ITPro.com). Advanced waste-recycling infrastructure is diverting waste from landfills and converting it into energy or reusable materials (Times of India, 2025). This progress is further supported by integrated waste-to-energy systems, recycled water systems, and green hydrogen systems. The private sector is increasingly using IoT data to track waste in line with environment, social and governance (ESG) compliance and reporting regulations. Sensor-equipped smart bins can divert tonnes of food scraps to composting facilities, while startups are exploring ways to convert hard-to-recycle plastics into reusable oil for high-quality virgin plastics (Heim, 2025; Resynergi). Furthermore, citizen science projects utilizing open-source technologies are generating an expanding pool of environmental open datasets (European Commission). Combined with growing nature-related datasets that quantify the real economic value of forests, rivers, wetlands, and other ecosystems, this work helps governments, businesses, and communities to understand why protecting nature is not only environmentally necessary, but financially sound (Brander *et al*, 2024).

An increasing number of payment for ecosystem services (PES) schemes are incentivizing communities to protect nature in exchange for financial compensation (Central Africa Forest Initiative, 2024). As environmental data increasingly becomes an integral part of digital public infrastructure, more and more people, and not only large companies or governments, are accessing and utilizing it to create hyper-local green entrepreneurial solutions (Farooqi, 2025). This also serves to promote greater adherence, among businesses of all sizes, to the International Court of Justice landmark advisory opinion on the obligations of States in respect of climate change, issued on 23 July 2025 (International Court of Justice).

2.1.5 Evolving political landscape

Political and policy trends show regional smart city strategies increasingly aligning with regional economic visions, with this alignment cascading into national visions that shape evolving national smart city policies and strategies (African Union, 2024; Institute of the Americas; Higherstudy.org, 2023; Republic of Korea, 2018). In addition, national smart city initiatives are converging at the intersection of digital, green, and energy strategies, and these strategies should also be taken into account for local adaptation initiatives at the level of individual cities (Ibrahim, 2024; Bayar *et al*, 2020; Government of India, 2024). Global guidelines emphasize that policies should prioritize citizen QoL over technology for its own sake (UN-Habitat, 2025; Dong *et al*, 2024; ADB, 2025).

Cities are also increasingly contributing to national policy frameworks, with collaborations between city councils and development banks helping to co-develop transit-oriented development policies (Times of India, 2025). Integrated visions, policies, and strategies are creating the conditions needed to invest in and incentivize local innovation and entrepreneurship ecosystems (businessyokohama.com, 2025).

Regional and national digital transformation strategies are setting connectivity targets, and positioning 5G, fibre-optic, and satellite-backed broadband networks as core public goods. Prioritizing rollout of broadband and local connectivity is significantly shaping budget allocations and regulatory focus (OECD, 2025).

The establishment of a central smart city coordinating body signals a strong political commitment, enables transversal collaboration across multiple stakeholders, and supports the embedding of digitalization into public sector strategy (Ministry of Digital Development and Information of Singapore, 2024). City IoT strategies are now starting to emerge and are contributing to the development of responsible and fair cross-sector IoT ecosystems, while the role of city IoT strategy director is becoming increasingly common (atlasofurbantech.org).

A growing number of widely available model smart city governance policies support global knowledge-sharing, thereby accelerating the responsible adoption of smart city technologies (WEF G20 Smart City Alliance). Smart city charters act as democratic political instruments that help establish a public agenda for digital urban transformation (Government of Brazil, 2021). However, political instability and frequent shifts in government priorities continue to impede long-term planning and major strategic decision-making in many countries.

Smart city systems are becoming increasingly integrated with national digital ID, mobile payment, and e-government platforms to enable and deliver services such as billing, social benefits, and permit app services. This convergence raises policy concerns around data portability, consent, and cross-agency governance (UNESCO, 2023). Some governments are introducing privacy impact assessment processes to proactively safeguard citizen privacy before deploying smart city technologies, while also updating personal data protection frameworks (Dessalgne, 2021).

The alignment of e-government and participatory governance with well-being economy indicators (OECD) is gaining traction. Cities are pioneering platforms that allow residents to propose, debate, and vote on urban initiatives, thereby strengthening accountability and legitimacy in shaping smart city futures (Wired, 2018; Fernandez-Monge *et al*, 2024).

Smart city policies and strategies are increasingly embedding climate resilience requirements into adaptation and mitigation measures from the outset, ensuring that green benefits are defined early and achieved in practice. Projects failing to define these green benefits are increasingly unlikely to receive approval or financing.

Universal design principles employed in the development accessibility policies is improving the inclusiveness of government digital services (Daily Sabah, 2024). At the same time, as cities scale sensors, AI, and analytics for city-wide operations, regulatory pushback on surveillance technologies is intensifying (UN-Habitat, 2025; OECD, 2025).

2.1.6 Evolving legal landscape

Legal developments are increasingly focused on data governance and the interoperability of data and technical solutions through regulations and open, portable standards that all providers are required to meet (OECD, 2023).

There has been a clear shift by policy-makers, both at national and city-level, from simply deploying sensors, to writing rules on who owns and controls city data, how it is shared, and how privacy is protected (ITU, 2020).

The exponential growth of data volumes, and the increasing need for access to such data, requires extensive capacity-building across all stakeholders involved in smart city development to manage and use this data effectively, and to create tailored governance for diverse urban contexts. International guidelines call for interoperable, standards-based, and open solutions so that cities can avoid single-vendor lock-in and build local skills and this has also resulted in changes to the language employed in requests for proposal (RFPs) and grant conditions (UN-Habitat, 2025).

Cities are establishing policy sandboxes and 'living labs' as formal infrastructures in which to test smart city solutions such as autonomous vehicles and smart street lighting (citcomai, 2024; techconnect.org, 2023). Living labs act as orchestrators in smart city ecosystems by fostering multi-actor partnerships and co-creation schemes (Fauth *et al*, 2024; Puerari *et al*, 2023). A formalized, inclusive, and legally codified living lab model helps to reconcile the tensions between experimentation and local government accountability (Voorwinden, 2023). Legal agreements and partnership frameworks integrate universities, the private sector, civil society, and community associations in smart city innovation processes (Mahmoud *et al*, 2019). Additionally, regional and global smart city networks and city protocols illustrate how legal collaboration frameworks can institutionalize cross-border and multi-level partnerships (ASEAN, 2024; City Protocol, 2024).

Digital personal data protection laws are being updated to reflect advances in smart city initiatives (OECD, 2023). Cloud-first policies and sovereign cloud backbones are being established to ensure compliance with data sovereignty requirements, while infrastructure is increasingly operated by local providers or by major cloud vendors in partnership with local entities (Butler, 2024). This ensures data residency, protection against foreign surveillance, and compliance with national laws. However, existing national and city cybersecurity strategies are often not well suited to the rapidly evolving, interconnected, and hackable smart city environment (Osuorah, 2025; IT Pro, 2025). Consequently, governments are setting cybersecurity baselines for suppliers in tender contracts, and cybersecurity laws are evolving accordingly.

E-commerce regulations are also evolving, providing lifecycle-based blueprints for secure, inclusive, and globally competitive digital commerce ecosystems (Geneva Internet Platform Digital Watch Observatory). Investment and special economic zone (SEZ) legislation is serving as an incentive for private sector investment in smart city developments. SEZs are designated areas within a city or country where economic activities are encouraged through special regulations and incentives, and can also serve as living labs. Meanwhile, procurement and PPP laws continue to evolve, placing growing emphasis on building local capacity, applying open standards, and using open, portable platforms to avoid proprietary lock-in (World Bank, 2022).

Environmental and sustainability legislation is also progressing and directly influencing smart city development. The International Court of Justice (ICJ) climate change advisory opinion of July 2025 implies that smart cities must integrate climate responsibility, human-rights principles, and environmental-duty frameworks into their design, operations and governance practices (Cleary Gottlieb, 2025).

Urbanization and land-use laws play a pivotal role in shaping smart city development, particularly in greenfield flagship sites. These laws establish the legal framework for sustainable urban planning, ensuring that new developments are environmentally responsible and socially inclusive from the outset (UN-Habitat, 2022).

New aviation laws are emerging around the use of unmanned aerial vehicles (UAVs) for logistics purposes, as well as for supporting first-responders and reducing 'urgent care' delivery loads (GNSS.AE, 2025; Department of Health, Abu Dhabi, 2021). Legislation and licensing frameworks for autonomous vehicles are also being developed.

2.1.7 Evolving ethical landscape

Ethical considerations are gaining prominence as increasingly data is collected and used for real-time decision-making by governments, citizens, private-sector startups, SMEs, and entrepreneurship ecosystem builders.

Although concerns about surveillance remain high, the targeted use of open data for crime prevention is increasing citizens' sense of safety (Ismagilova *et al*, 2020; Smart City SS, 2025).

AI and automation play a critical role in analysing data for decision-making purposes relating to public services and citizen engagement. This has prompted continued exploration into ethical AI frameworks and regulations. Meanwhile, the role of Gen-AI in public services and everyday decision-making is being considered by city authorities, though attitudes remain ambivalent (Johns Hopkins University Bloomberg Center for Government Excellence, 2023).

There is growing focus on privacy-by-design, purpose limitation, and human oversight in AI use, for example in safety or eligibility decisions. There is also increasing concern about algorithmic social engineering (ASE) and the need to ensure algorithmic transparency and auditability for public-interest models (Prism).

Data curated from city spaces highlights the need to prevent private companies from exploiting open data to generate substantial company revenues (Times of India, 2025). There have been instances where citizen data collected through public e-kiosks has been used to generate revenue for governments and private providers, raising important questions about data ownership (Wavetec, 2025).

Global guidelines and smart city policies that emphasize inclusion, especially with regard to informal economy workers and residents of informal settlements, reflect a growing awareness that digital transformation in cities should not deepen poverty or exclusion (Department of Economic and Social Affairs, 2021; World Bank, 2025). Smart cities are also increasingly focused on accessibility and participation for persons with physical, mental or learning-related disabilities, as well as for elderly populations, through the development of barrier-free design, digital inclusion leadership, and accessibility standards (Ruh, 2022; Kolotouchkina *et al*, 2022).

Governance frameworks are embedding participatory practices to ensure that marginalized groups, including migrants, older adults, and persons with disabilities, are able to actively participate in shaping smart city futures (Kourtidou *et al*, 2025; SmartCities4All). Equity principles increasingly guide capability-based urban design, ensuring that resources are converted into well-being outcomes fairly across communities (Kruhlov, 2024).

Explorations into e-waste generated by smart city technologies, such as the e-waste associated with data centres, remain only nascent (Ernst, 2025). The same is true of the development of sensor end-of-life strategies and their integration into sustainability planning (Swiss Quality Consulting).

Ethical considerations are increasingly shaped by local custom and laws, with concepts such as local citizenship offering inclusive legal frameworks that extend public services access and participation to migrants and informal settlers (Setiawan, 2025).



3 Analysing and refining key drivers of change

This section explores the second phase of the foresight process: analysing and refining drivers of change. Building on the insights derived from the previous phase, key drivers are identified and assessed based on their potential impact on the future and the degree of uncertainty surrounding their realization. Efforts are also made to look for weak signals, which are early, often ambiguous signs of emerging change that may evolve into significant drivers over time.

3.1 Drivers and critical forces influencing future evolution of smart cities

Drivers shaping the future of smart cities

The future of smart cities is being shaped by a number of powerful drivers and interconnected forces, each of which plays a vital role in influencing the evolution of urban landscapes. Drivers are the key forces or underlying factors that influence or shape change within a system. They often interact with each other and evolve over time, reflecting their interdependencies and how they may shape future scenarios. While these interconnected driver forces present both opportunities and challenges, the extent to which they impact, and the degree of certainty, vary. Together, however, they offer an overall view of the anticipated transformations, across social dynamics, economic shifts, technological advances, environmental imperatives, and institutional reforms.



Mega drivers are clusters of interrelated drivers that exert a larger, systemic influence on change within a system collectively. Mega drivers are broader in scope, cutting across sectors and domains, and represent overarching forces that shape and accelerate the trajectory of multiple underlying drivers. The drivers and mega drivers identified and presented here reflect the most influential forces likely to shape the evolution of the smart city landscapes, globally.

Table 1: Drivers shaping the future of the smart city landscape

Mega driver	Interrelated driver	Impact	Uncertainty
Policy alignment	Integrated visions, policies, regulations, and strategies	High	High
	Focus on quality of life (QoL)	High	Medium
	Cybersecurity and citizen privacy	High	High
Operational capacity	Digital infrastructure and adoption of emerging technology	Medium	High
	Access to open data and data interoperability	High	High
Strategic support	Governance and accountability	High	Medium
	Partnerships and investment	High	Medium
	Entrepreneurship ecosystems	High	High
	Citizen and community engagement and participation	High	High
	Climate resilience	High	High
Ecosystem capacity	Capacity building and lifelong learning	High	Medium

To complement the qualitative analysis of each mega driver and its associated interrelated drivers, the table qualifies them according to both their systemic impact and the degree of uncertainty surrounding their potential evolution. A shift in any one of these could fundamentally redirect the pathway of smart city evolution. Each of the mega drivers and associated interrelated drivers listed in the table are discussed in more detail in the next section.

3.2 Mega drivers and associated drivers

Understanding the impact and uncertainties surrounding mega drivers and associated interrelated drivers

Mega driver: Policy alignment

A unified policy direction that strengthens coordinated urban development, prioritizes QoL, and safeguards citizen trust and digital rights. These mega drivers can have both a high level of impact, as well as a high level of uncertainty, as shifts in political coherence, trust, and privacy protections can rapidly accelerate or stall smart city progress.

Interrelated drivers associated with policy alignment: Integrated visions, policies, regulations and strategies provide a coordinated approach to regional, national and city planning, with coherent policies for people- and planet-centred urban development. Smart city charters serve as democratic frameworks that guide consistent implementation and participation, while adaptable multi-level strategies mitigate the risks associated with political instability.

A focus on quality of life (QoL) ensures that urban transformation prioritizes inclusion, equity, and accessibility, by providing public services, education, and mobility for all citizens. Investment in transport, clean air, and urban greening responds to demographic and cultural shifts, as well as rising citizen expectations regarding liveability.

Cybersecurity and citizen privacy are paramount for building trust. At a time of escalating cyber risks, and as cities are exploring ethical AI frameworks, privacy-by-design principles, human oversight, and algorithmic transparency must ensure responsible data use, while navigating the emerging role of generative AI.

Mega driver: Operational capacity

Smart cities require a digital backbone and technical readiness in order to deliver interoperable, data-driven, and inclusive services. The impact of these mega drivers is high-to-medium, but the level of uncertainty is also high because infrastructure maturity and technology adoption can vary widely and change rapidly.

Interrelated drivers associated with operational capacity: Digital infrastructure and adoption of emerging technology ensures that high-quality connectivity underpins citizen-centred services, enabling real-time decision-making via IoT, AI, and open data platforms. Mobile-first and low-bandwidth strategies promote digital inclusion among underserved populations.

Access to open data and data interoperability facilitates data-driven business models and includes citizens and the informal economy. It also catalyses new urban technology startups and SMEs.

Mega driver: Strategic support

Strategic support encompasses the institutional and financial enablers including governance, accountability, and investment, that sustain smart city implementation and innovation. While these mega drivers have a high impact, they also carry medium uncertainty, as strong governance and financing enable progress, but institutional or market shifts can affect stability.

Interrelated drivers associated with strategic support: Governance and accountability frameworks support the use of open and portable standards while ensuring the secure, transparent, and citizen-centred use of data to enhance decision-making and innovation.

Partnerships and investment focus on outcome-based procurement and innovative funding models via public-private partnerships (PPPs), which strengthen institutional capacity and economic resilience. Cross-sectoral and cross-border partnerships facilitate knowledge-sharing and trade deals.

Mega driver: Ecosystem capacity

Ecosystem capacity refers to the collective capabilities of entrepreneurs, communities, and institutions to innovate, adapt, and build resilient, future-ready urban systems. These mega drivers have a high impact and are also subject to high levels of uncertainty, as ecosystem strength depends on social, economic, and institutional dynamics that evolve in an unpredictable manner.

Interrelated drivers associated with ecosystem capacity: Entrepreneurship ecosystems require innovation hubs, special economic zones (SEZs), and open-data platforms to foster cross-sector entrepreneurship. Startups and SMEs drive urban technology innovation, including hyper-local, citizen-centred, sustainable solutions.

Citizen and community engagement and participation is expanding with participatory planning via e-government and 3D tools, to enhance trust, ownership, and relevance in urban development. Citizen science is facilitating community-led initiatives and decentralized energy and water solutions.

Climate resilience to ensure that cities are liveable spaces means integrating adaptive infrastructure and emergency preparedness measures to mitigate against climate shocks. Green technology innovations, water management, urban greening, nature-based solutions, and decentralized renewable energy promote inclusive and resilient urban development.

Capacity building and lifelong learning including sector-specific training on emerging technologies and sustainability ensure workforce readiness in an ever-transforming urban economy. Blended learning programmes support equitable access for informal populations and empower startups, SMEs, and public sector actors to take the lead in creating smart sustainable city solutions.

3.3 Weak signals with disruptive potential

Potential disruptors that could redefine sectors

Often overlooked or underestimated, weak signals are unpredictable forces that can either catalyse or hinder the evolution of systems. The following signals, though varied in maturity and visibility, warrant closer attention because of their potential to shape the near-, medium- or long-term evolution of smart sustainable cities.

Data infrastructure (near-term)

Cities are piloting open-source dashboards and citizen-owned data platforms to give residents transparent access to urban data. These initiatives suggest a future model in which communities can collectively manage, share, and benefit from urban data.

Decentralized energy (medium-term)

Blockchain-based local energy trading allows residents to exchange surplus solar energy by merging digital infrastructure with local energy systems. Pilot schemes suggest the potential for large-scale, decentralized, self-sufficient community energy grids (Brooklyn Microgrid; Quartierstrom).

Non-extractive water management strategies (near-term)

Water management strategies are shifting from traditional extractive water management, which focuses on consumption and disposal, to non-extractive water management strategies that emphasize water reuse, natural filtration, and ecosystem restoration. These approaches aim to integrate water management systems with urban ecosystems to promote sustainability and resilience (SpongeCity; European Commission).

Hyper-local green and clean technology startups (near-term)

Hyper-local green and clean technology startups are creating do-it-yourself environmental sensors and monitoring tools for air, water, noise, and energy data. These grassroots innovations enable citizens and communities to generate and utilize environmental data directly (Lixia.com; Smart Citizen).

IP as collateral (long-term)

Startups are using intellectual property, such as patents and trademarks, as collateral for loans, bypassing the need for physical assets or a credit history. This enables high-tech startups with valuable IP focused on smart city solutions, to access financing for rapid scaling (Otorbaev, 2024).

Charter city platforms as semi-autonomous ZEDEs (medium-term)

Zones for employment and economic development (ZEDEs) have their own legal, fiscal, and regulatory framework designed to attract entrepreneurs with low taxes and flexible regulations. As autonomous cities, they have the potential to drive hyper-concentrated smart city innovation (Myles, 2025).



4 Visualizing possible future scenarios

Possible transformational scenarios

This section presents the process of envisioning a diverse set of possible futures by examining how selected drivers of change might interact and intersect over time. Through structured exploration, several scenarios have been developed, each of which reflects a different combination of risks, opportunities, and system dynamics.

These scenarios are then studied to understand their implications, including their potential strengths, vulnerabilities, and cascade effects on a possible future smart, sustainable community.

4.1 Key drivers for exploring potential future scenarios

Tensions expected to critically influence system dynamics over time

To explore how smart city landscapes might evolve around the world, and particularly in developing countries, the strategic foresight study began by mapping over 200 signals and identifying the key drivers of change. As indicated previously, these drivers are the forces expected to have a significant influence on smart city system dynamics over time. From a broader set of eleven associated interrelated drivers, four overarching and impactful mega drivers were grouped together based on their potential to impact the objectives of the strategic foresight study.

These mega drivers were then paired to reflect their interconnectedness, and the critical tensions and/or trade-offs that are likely to emerge in the future. The mapped pairs offer a distinct perspective on how the future could evolve, yielding a contrasting set of potential future scenarios. For this study, the combinations of these mega drivers were explored, with each mega driver reflecting a key axis of uncertainty and opportunity.



Table 2: Mega drivers selected to explore the interplay shaping scenario development

Mega driver	Impact	Uncertainty
Policy alignment	High	High
Operational capacity	High	High
Strategic support	High	Medium
Ecosystem capacity	High	High

Operational capacity x policy alignment: Reveals the tension between regulatory ambitions and the technological capacity required to implement them effectively.

Operational capacity x policy alignment + strategic support: Reveals tensions between the speed of technological implementation, the coherence of regulatory frameworks, and the accountability of governance and partnerships.

Ecosystem capacity x operational capacity + policy alignment: Reveals tensions between grassroots innovation, the infrastructure required to scale it, and the regulatory frameworks that shape its direction.

Policy alignment + strategic support x operational capacity + ecosystem capacity: Reveals tensions between top-down policy and governance ambitions, the limits of technological capacity, and bottom-up community needs and participation.

This final driver combination (policy alignment + strategic support X operational capacity + ecosystem capacity) captures the need to have all the components in place to deliver the promise of QoL for and with citizens. While other pairings deliver some transformational elements, further investment in, and alignment across other mega drivers is required to realize the vision of smart communities.

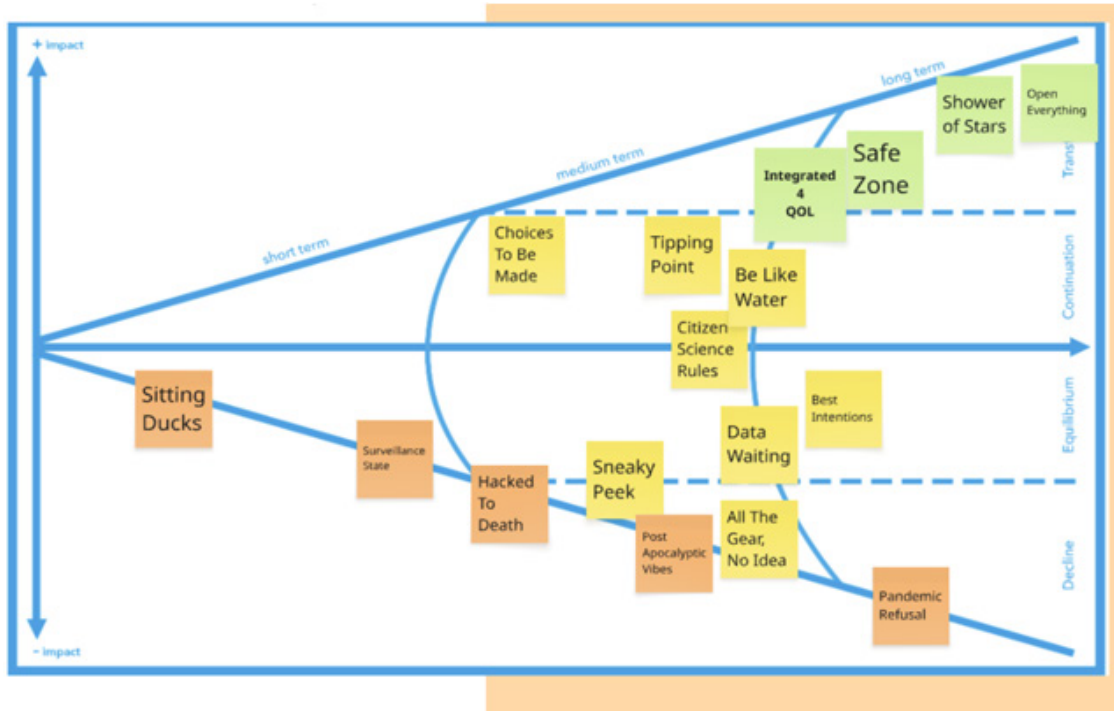
4.2 Exploring a range of scenarios

Potential directions for the future landscape of smart cities

The future of smart cities and smart communities is explored through a set of diverse scenarios, each of which is shaped by different combinations of critical drivers. These plausible futures span a wide spectrum, illustrating paths ranging from fragmentation to alignment, and scarcity to innovation. Together, they present a range of potential directions shaped by varying levels of impact and uncertainty linked to the most relevant drivers. The ITU Playbook on Strategic Foresight uses an adapted futures cone to map out how these scenarios could play out over time.

The timeline for these scenarios varies from the short term (zero to five years) to long term (15 to 20 years), depending on how quickly uncertainties develop and how system-level responses take shape. In addition, a wildcard scenario was also explored to consider potential high-impact disruptions to current trajectories.

Figure 3: Potential trajectories and outcomes



Source: ITU's strategic foresight playbook

In each of the scenario sets presented here, the scenarios shown in the lower trajectory from sitting ducks to pandemic refusal in Figure 3 represent a path of decline, while the scenarios rising toward long-term transformation reflect a more positive and transformative direction. Countries that find themselves aligned on the lower trajectory scenarios are encouraged to reflect on their position and consider how they might shift towards more desirable futures.

4.3 Envisioning scenarios through the interplay of key drivers

The following scenarios have been identified through an assessment of the interplay between key drivers. The four scenario matrices presented in Figures 4-7 illustrate how different combinations of these drivers can generate distinct yet realistic possible futures. They highlight the strategic choices and systemic conditions that could shape the long-term development trajectories of smart sustainable cities and communities.

Figure 4: Navigating policy alignment vs operational capacity

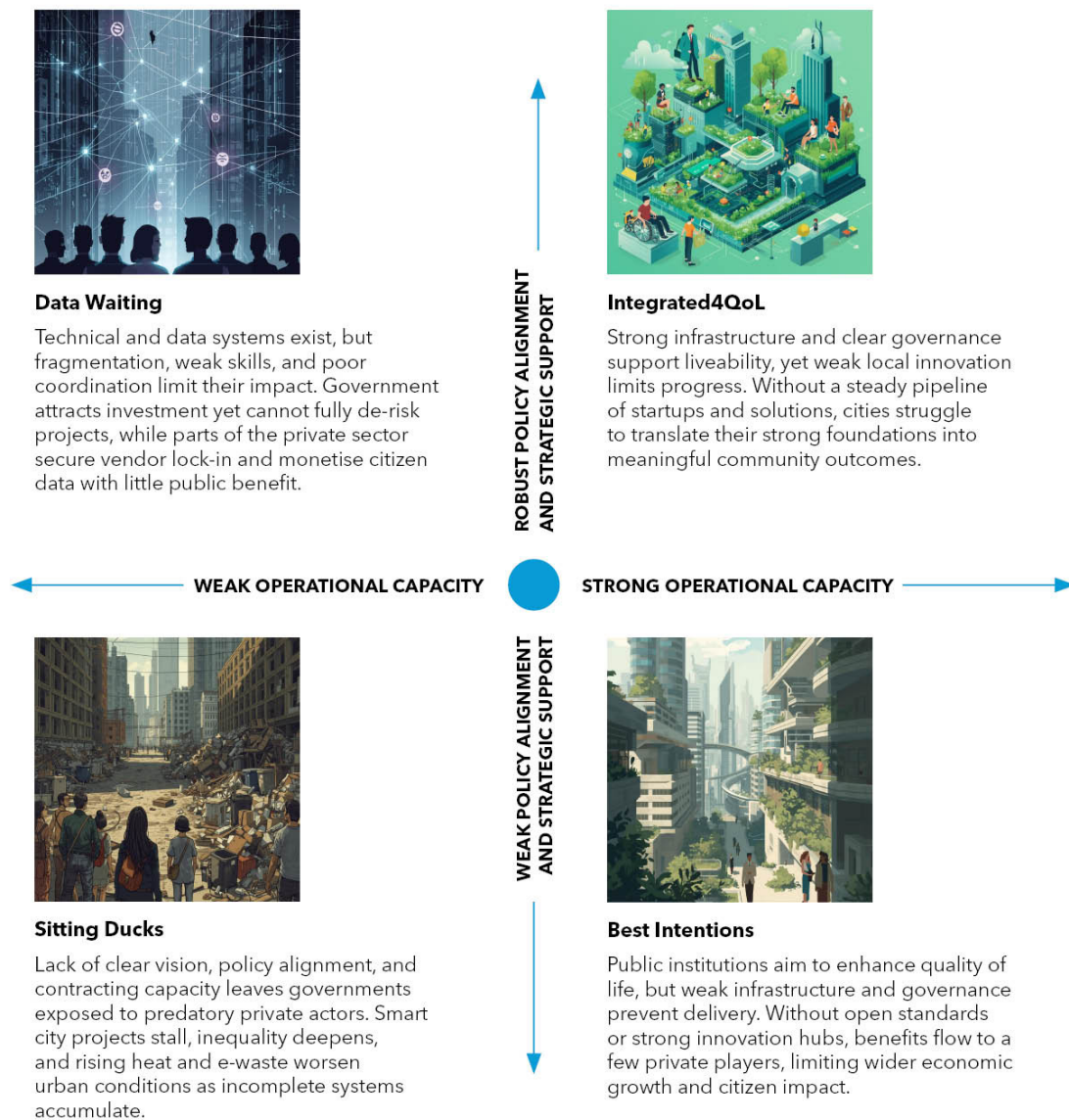


Source: ITU

Four possible scenarios are presented in the figure, each of which explores alternative futures for smart cities by considering the interplay of policy alignment and operational capacity. Together, these drivers reflect the coherence of strategic direction and governance priorities, as well as the ability of institutions and ecosystems to translate ambition into action and delivery.

This matrix illustrates four distinct scenarios ranging from citizen-led innovation emerging in an environment where strong vision exists but operational delivery capacity is limited (citizen science rules), to secure and stable systems where alignment and capability reinforce each other (safe zone). Other scenarios include technologically advanced yet fragmented environments lacking clear direction (all the gear, no idea), and fragile and crisis-prone cities where weak governance and limited operational delivery capacity compound systemic risks (hacked to death).

Figure 5: Navigating policy alignment and strategic support versus operational capacity



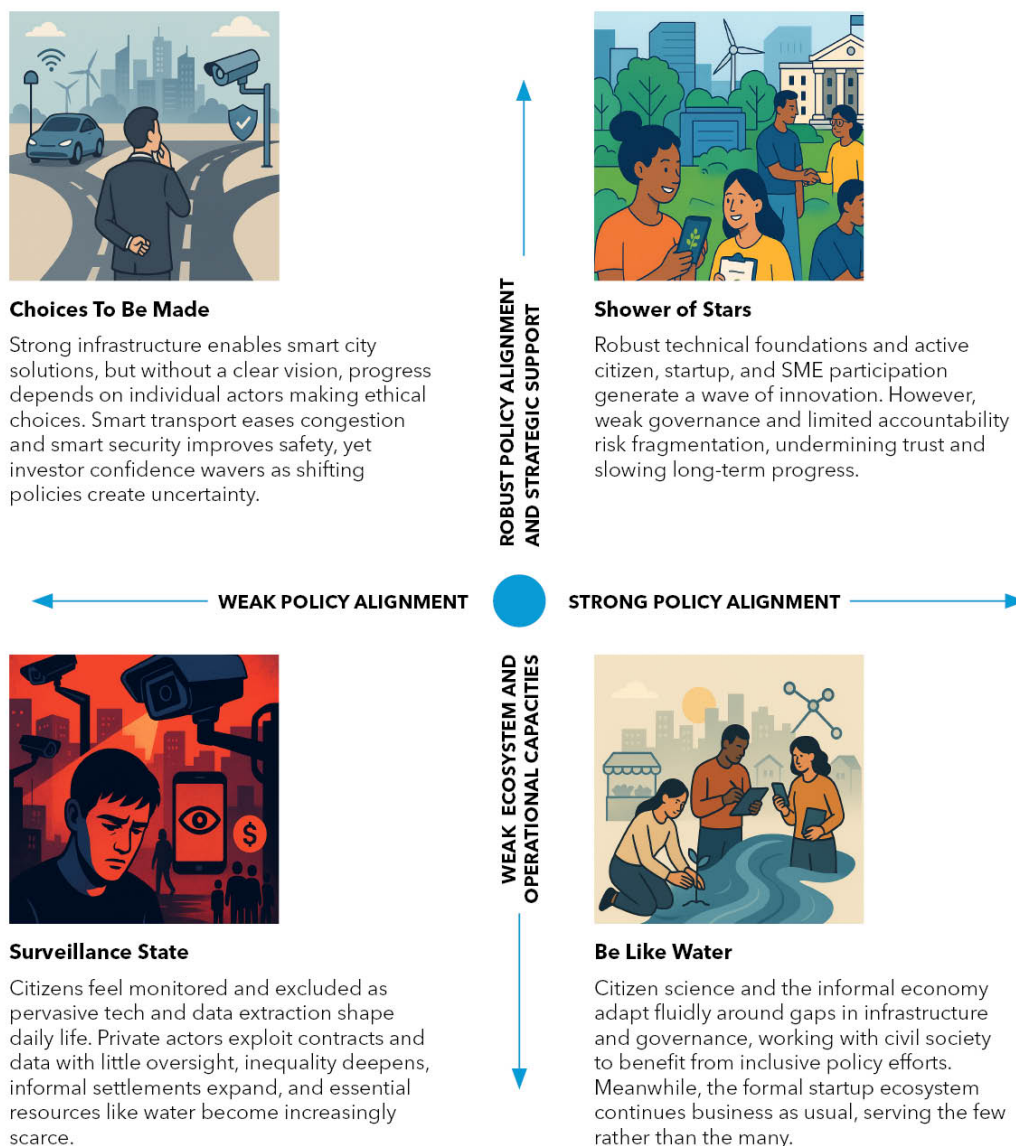
Source: ITU

Figure 5 presents a set of four possible scenarios that explore the interaction between policy alignment and strategic support, alongside operational capacity. Together, these drivers reflect the coherence of vision and regulatory frameworks, the strength of governance and partnerships, and the ability of institutions to deploy infrastructure, data, and emerging technologies effectively.

This matrix illustrates four distinct scenarios ranging from environments where technical systems exist but fragmentation and weak coordination limit public value (data waiting), to environments where strong governance and infrastructure create a stable foundation yet local innovation struggles to scale impact (integrated4QoL). Other scenarios include cities driven by quality-of-life ambitions that outpace delivery capacity (best intentions), and vulnerable scenarios where

weak alignment and limited capability leave governments exposed to stalled projects and mounting systemic pressures (sitting ducks).

Figure 6: Navigating ecosystem and operational capacities versus policy alignment



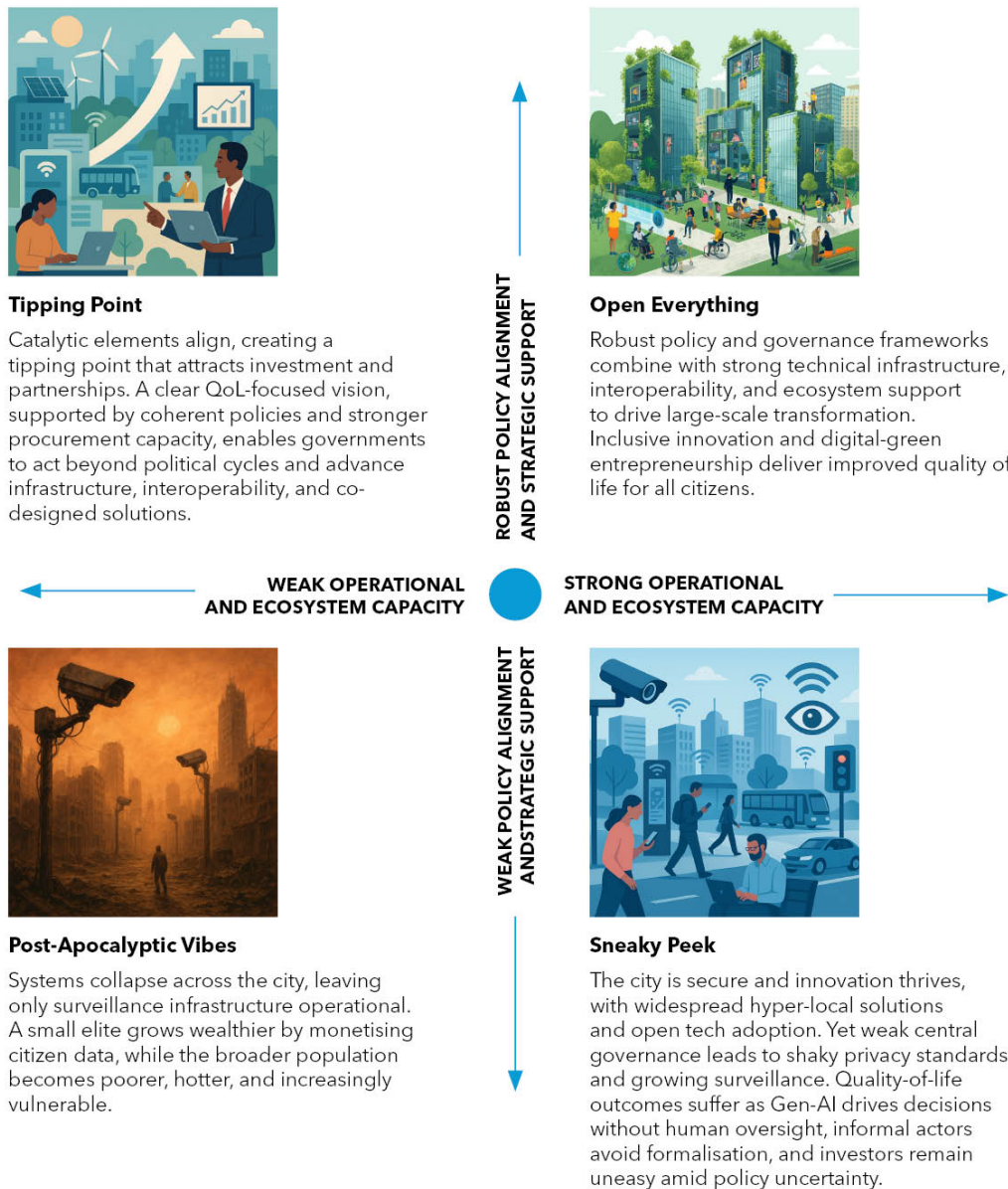
Source: ITU

The set of scenarios presented in Figure 6 examines the interplay between policy alignment, and ecosystem and operational capacities to explore alternative futures for smart cities. Together, these drivers reflect the coherence of strategic direction and public-interest safeguards, the strength of digital infrastructure and data systems, and the vibrancy of entrepreneurship, community participation, and adaptive capacity within the wider ecosystem.

This matrix illustrates four distinct scenarios ranging from infrastructure-rich environments where progress hinges on individual ethical choices amid shifting policy signals (choices to be made), to innovation-driven cities powered by strong technical and ecosystem foundations, yet constrained by weak governance and accountability (shower of stars). Other scenarios include

controlled and extractive systems where weak alignment enables surveillance and deepening inequality (surveillance state), to adaptive, community-led contexts where informal and civic actors navigate gaps in infrastructure and governance under more inclusive policy conditions (be like water).

Figure 7: Navigating policy alignment and strategic support versus operational and ecosystem capacity



Source: ITU

The set of scenarios presented in Figure 7 examines interplay between policy alignment and strategic support, and operational and ecosystem capacity, to explore alternative futures for smart cities. Together, these drivers reflect the coherence of long-term vision and governance frameworks, the strength of infrastructure and data systems, and the depth of partnerships, entrepreneurial dynamism, and community engagement that enable delivery at scale.

This matrix illustrates four distinct scenarios ranging from catalytic moments where aligned vision, procurement strength, and partnerships unlock sustained transformation (tipping point), to comprehensive and inclusive transformation where robust governance, infrastructure, and ecosystem capacity reinforce one another (open everything). Other scenarios include contexts where innovation flourishes locally but weak central oversight creates privacy risks and uneven outcomes (sneaky peek), to systemic breakdown scenarios where weak alignment and limited capacity leave cities vulnerable to surveillance, inequality, and climate stress (Post-apocalyptic vibes).

4.4 Wildcard events

Potential disruptions to the future evolution of smart sustainable cities

In addition to the driver-based scenario mapping, several wildcard events were also identified. These are low-probability events capable of overturning assumptions. The following wildcard scenarios explore disruptive developments that could hinder the envisioned evolution of smart sustainable cities. These scenarios represent external or internal shocks with the potential to disrupt progress and preparedness, even in otherwise favourable future scenarios.

Pandemic 2.0

A future pandemic that is deadlier or more disruptive than COVID-19 reshapes urban planning towards biosecure, hyper-local, and digitally networked communities. The focus is on maintaining water, energy, and waste management systems. Early warning indicators include:

- a surge in demand from citizens for biosecure public infrastructure, such as touch-free services.
- cities moving towards decentralized energy and waste management models, where local neighbourhoods can function autonomously during outbreaks; and
- governments impose strict, prolonged lockdowns and localized quarantines, leading to the unintended creation of fragmented urban networks.

Climate extremes

Weather shocks surpass forecasts as planetary boundaries are breached. Urban planners must anticipate and retrofit for these extremes. In order to be viable, smart cities require radical new urban design features, such as floating neighbourhoods, modular housing, and extensive 'de-tarmac-ing' or removal of asphalt (tarmac), or other impermeable paving and replacing it with permeable surfaces, vegetation, or other features that improve drainage and reduce flood risk. Early warning or early indicators include:

- weather anomalies that exceed accepted climate models, demonstrating that planetary boundaries have been surpassed, triggering emergency retrofits;
- breakdowns in urban infrastructure insurance and financing as major insurers, reinsurers, or sovereign wealth funds start to withdraw from coastal or heat-prone metropolitan areas due to high loss risks; and
- cascading infrastructure failures affecting critical systems such as power grids, cooling networks, and water supply, causing mass displacement or urban unrest.

Citizen refusal

Citizens either fail to adopt, or actively reject smart city services, such as public e-kiosks, or traffic management and policing systems based on cameras and AI-analysis, due to privacy and trust concerns about their data being collected and monetized. Tensions rise and government officials fail to implement change. Early warning indicators include:

- citizens increasingly boycotting or disabling smart services resulting in adoption rates for smart platforms stagnating;
- community movements demanding the right to digital anonymity in urban spaces; and
- technology-savvy citizens opting out of smart city systems, creating a digital divide.

Ecosystem and biodiversity integration

Earth Law is prioritized in urban blue/green regenerative solutions, with biodiversity care becoming a core element of city infrastructure, including urban forests, rivers, and wetlands. Citizens' well-being and health improve. Cities shift from being human-centric to integrated ecological systems, radically altering energy, water, and urban planning models. Early warning indicators include:

- rivers, forests, or wetlands within city boundaries are granted legal rights or personhood embedding ecological thinking into urban governance;
- cities begin investing in living systems and introducing green/blue systems; and
- deployment of real-time biodiversity dashboards and green digital twin cities.

Hacked and disrupted

Smart cities depend on large-scale, secure data flows. A lack of adequate cybersecurity can result in entire smart cities being hacked, bringing them to a standstill, and losing billions from city economies. Such disruptions break citizens' trust in initiatives, causing many to be ceased. Early warning indicators include:

- cities start experiencing frequent ransomware attacks or system outages affecting public systems;
- IoT devices, such as smart meters, cameras, and sensors are used as entry points to infiltrate networks or disrupt services; and
- a coordinated cyberattack hits multiple essential systems, such as power grids, traffic control, water treatment, and emergency services simultaneously, causing city-wide paralysis for days or even weeks.



5 Prioritizing the desired scenario

This section stress-tests the scenarios identified so far, against the objectives of the study to assess their potential impacts and alignment. Using this assessment, a desired scenario is identified and analysed, offering a shared vision to guide planning and decision-making.

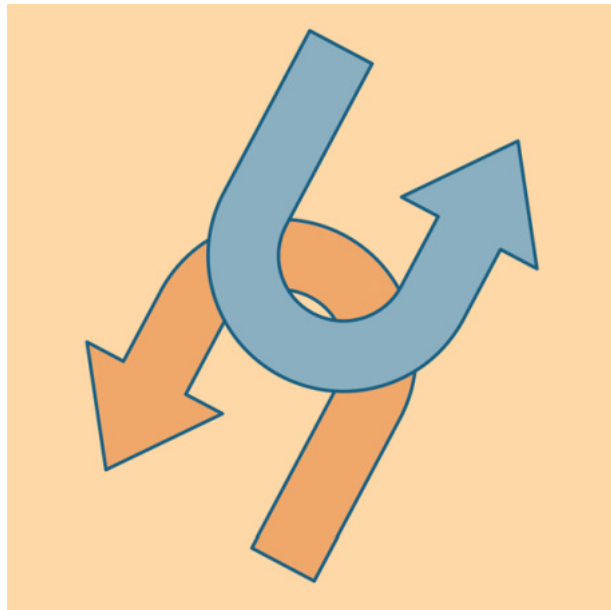
5.1 Four transformational scenarios

Analysing optimistic futures for lasting progress

A set of transformational scenarios has been shortlisted and examined through collaborative analysis, stakeholder engagement, and expert review. These scenarios illustrate a range of potential pathways, which are shaped by varying degrees of impact and uncertainty linked to the most relevant drivers of the future of smart cities. A wildcard scenario, which is low-probability but high-impact, and has the potential to significantly disrupt current trajectories, is also considered.

The following pages introduce these shortlisted scenarios and their narratives, which were developed based on the preceding analysis of signals and drivers. This will support the prioritization of a desired future vision, which will then guide the strategic recommendations that follow.

Although the four scenarios may appear similar in ambition and direction at first glance, each reflects a distinct blend of capacities, trade-offs, and systemic behaviours that create markedly different futures.



5.2 Visualizing transformational scenarios

Figures 8 to 11 serve to visualize and discuss potential future transformational scenarios.

Figure 8: Safe zone



Source: ITU

In this future scenario, strong foundations for citizen participation are created through policy and technology, but innovation remains slow without the meaningful involvement of citizens, startups and SMEs. Without a clear vision or robust governance, solutions become fragmented, costly, and vulnerable to exploitation. Nevertheless, the government leads the shaping of a collaborative, multi-stakeholder landscape, turning the concept of smart sustainable cities into a lived reality. Long-term thinking is embraced, with decisions guided by the goal of improving

QoL for citizens. Urban transformation is co-designed with communities to ensure that visions are grounded in real-life experience and evolve alongside citizen priorities.

The backbone of this transformation is a city-as-a-service platform that has been engineered to provide world-class cybersecurity making it exceptionally secure. These digital infrastructures are not only safe, they are also trusted. Citizens understand that their well-being depends on systems that never fail, and startups build their reputations on delivering precisely that. At the same time, open data becomes a public asset. Instead of being used primarily for private gain, the government monetizes the city-as-a-service platform transparently and reinvests the revenues into public services. This creates a virtuous cycle in which open innovation strengthens education, healthcare, energy systems, and public spaces.

The private sector thrives in this environment. Although some firms still exploit loopholes and weak contracting expertise in PPPs, most now comply with open standards. Nevertheless, the balance of power has shifted and compliance is expected, while public scrutiny ensures that private profit does not take precedence over public purpose. Investors are energized by this government-led model, particularly the citizen science initiatives and solopreneur-driven 'digital green unicorns,' where local ingenuity meets scalable digital platforms. Entrepreneurship network builders lobby the government for special economic zones (SEZs) and innovation hubs, seeking to nurture the next wave of digital green entrepreneurial solutions, especially in the expanding cybersecurity market. However, support remains uneven and is not yet system-wide. Civil society ensures that inclusion is not overlooked, advocating for the informal economy to be embedded in smart city design, and insisting that every citizen has access to data and digital security.

This is a possible future in which strong policy alignment and operational capacity provide coherence and stability across the landscape. However, challenges remain and the entrepreneurship ecosystem lacks depth, particularly for startups progressing beyond the pilot stage. Long-term strategic support is still needed to help promising digital and green ventures scale sustainably.

Figure 9: Integrated4QoL



Source: ITU

A strong technical and data infrastructure, supported by highly interoperable systems and robust governance, enables smart sustainable cities to prioritize liveability. However, there are only limited opportunities for local innovation as decisions across government, businesses, and society are guided by a single, unifying measure of maximizing QoL for all citizens. Public value is assessed in terms of health, well-being, and environmental sustainability rather than short-term profit. The government and public sector have undergone significant transformation. Procurement and contracting are no longer bureaucratic bottlenecks but strategic levers for innovation. Civil servants are equipped to ensure that all x-as-a-service systems are interoperable and aligned with open standards, as well as being connected to targets for water efficiency, energy transition, and community well-being. Vendor lock-in is being steadily eliminated to increase the flexibility and resilience of service delivery.

Civil society actors thrive in this environment. Citizen science initiatives flourish, including those within the informal economy. Equipped with simple mobile-first tools, communities can collect and contribute open data on health, the environment, and livelihoods. However, they still lack the means to translate this into economic empowerment. The private sector is actively engaged, recognizing the potential of open data to accelerate innovation and monetization. However, robust government protocols ensure that privacy and public benefit remain paramount, and that companies innovate without ever infringing on citizens' rights.

Investors have confidence in this coherent and contractual landscape, as they are reassured that initiatives will deliver tangible public value, and that their capital will both yield returns and improve lives.

However, challenges persist and the entrepreneurship ecosystem lacks true depth and resilience. While operational systems, strategic support, and policy alignment are firmly in place, there is insufficient focus on expanding and sustaining the capacity of startups and SMEs, which are the engines of innovation needed to power this QoL-first future. Despite being values-driven and united around well-being, this possible future requires deeper investment in entrepreneurial and grassroots ecosystems to sustain momentum.

Figure 10: Shower of stars



Source: ITU

In this future, a strong technical and data infrastructure, combined with significant contributions from citizen scientists, startups and SMEs, creates a surge in smart city solutions, which are enabled by supportive policies. However, the absence of robust governance and accountability can lead to fragmentation and reduced trust. Government and the public sector act as master catalysts, translating visions of smart sustainable cities into tangible local action.

Every step of the initiative design process involves citizens, from gamified apps and public kiosks to participatory charters and inclusive procurement processes that favour local startups and SMEs. Urban interventions are co-created to embed community ownership from the outset. Citizens from all backgrounds can play an active role in hyper-local innovation. They participate in citizen science initiatives, co-design urban solutions, and collect data that fuels new ventures

and data-driven business models. These contributions form the backbone of local innovation ecosystems, transforming everyday observations into insights that improve city services and stimulate entrepreneurial activity.

Civil society actors safeguard inclusivity. Mobile-first, low-cost, and low-bandwidth solutions enable widespread participation from the informal economy. Continuous advocacy ensures that universal access design becomes a core principle in every new government initiative. Digital engagement becomes a cultural expectation. Entrepreneurship network builders thrive in this environment. They provide training, funding, and mentorship, facilitating the rise of data-driven, cross-sectoral, and x-as-a-service platforms. Urban technology startups and SMEs flourish by leveraging open datasets, coherent policy incentives, and the advantages of innovation hubs and SEZs. Business-to-business (B2B) models multiply, linking local innovations with city needs and global markets.

Confident in the alignment between innovation and public benefit, investors direct capital towards ventures with clear social and economic value. They actively seek out the next community-driven 'unicorn,' with particular interest in IP-backed fintech, and climate and water management solutions. The private sector also capitalizes on this momentum. Vendors increasingly seek partnerships with agile local startups and SMEs, recognizing that community-rooted solutions are faster, more cost-effective, and more easily gain social acceptance than top-down corporate offerings.

Despite its strong ecosystem capacity, robust policies and advanced operational systems, a gap remains and the system lacks sufficient depth in long-term strategic support. Without sustained, coherent guidance, many innovations struggle to develop and scale into enduring, city-wide transformations.

Figure 11: Open everything



Source: ITU

In this future scenario, smart sustainable cities are guided by one unifying principle of maximizing quality of life (QoL) for all citizens. All regulations, policies, and strategies are underpinned by digital innovation, universal access, green technologies, and responsible water and energy management.

Government leads decisively, moving from vision to action using a multi-stakeholder approach that aligns policies, strategies, and governance at national and local levels. Legislation evolves proactively to anticipate emerging technologies before they create risks. Public-sector capacity is strengthened through targeted training to ensure compliance with public-private partnerships (PPPs), avoid vendor lock-in, and manage emerging domains such as ethical AI, interoperability, cybersecurity, privacy, and x-as-a-service models. As a result, citizens have access to seamless,

well-organized smart public services. Urban life is powered by clean energy, efficient transport systems, and vibrant, intergenerational communities. Civic participation becomes a cultural norm with residents co-designing neighbourhood solutions, contributing open data, engaging in urban planning, and serving on assemblies that oversee ethics, privacy, and sustainability issues.

Cities evolve as living laboratories of QoL-driven innovation. Blue/green infrastructure cools and cleans neighbourhoods, while circular systems, such as smart energy grids, water recycling loops, and waste-to-resource technologies are widely adopted. Decentralized community-led energy models thrive, supported by startups, SMEs, and citizen scientists who use open datasets to build cross-sector digital-green solutions.

The innovation ecosystem flourishes at multiple levels. SEZs and localized innovation hubs provide access to investment, partnerships, mentoring and R&D support. Startups, SMEs, universities, informal enterprises, and citizen innovators generate scalable business models across smart city-related sectors. Informal economy actors participate meaningfully, often monetizing open data sets and gaining new pathways to formalization.

Civil society remains a vital force for accountability, advocating for universal access design principles and ensuring inclusivity across all initiatives. The private sector collaborates through robust PPPs, adhering to open standards and partnering with local enterprises to advance environmental, social and governance (ESG) goals. Investors are energized by this coherent, long-term policy environment, directing capital towards resilient, ethical, and future-focused ventures.

Cross-border collaborations are deepening, leveraging soft diplomacy, talent mobility, and knowledge-sharing to spread innovation globally. The result is a technologically advanced, environmentally sustainable, and socially equitable urban ecosystem in which the well-being and dignity of citizens guide every decision.

5.3 Visualizing a wildcard future scenario

In addition to the four transformational scenarios already considered, which were developed through an assessment of the interplay between key driver combinations, a wildcard future scenario was also explored. A wildcard scenario represents a low-probability yet high-impact development that, while uncertain, could significantly disrupt prevailing assumptions and alter the trajectory of the system under examination.

Figure 12: Pandemic refusal



This wildcard scenario acts as a thought-provoking narrative, combining the 'Pandemic 2.0' and the 'Citizen refusal' scenarios and taking them to their extremes to demonstrate how converging crises can rapidly destabilize even well-designed smart city systems.

A devastating new pandemic accelerates demand for digital, contactless, and smart solutions in cities even as trust in government declines sharply. At the same time, citizens reject pervasive data collection, surveillance practices, and corporate-led smart city services due to concerns around privacy, equity, and misuse of personal information. This creates a profound paradox wherein cities urgently require technology-enabled resilience, yet face social resistance and governance failures that hinder implementation.

Amid widespread distrust, entrepreneurs struggle to deploy smart health and safety solutions, prompting a pivot towards privacy-preserving, decentralized, and community-owned technologies. Entrepreneurship network builders attempt to redesign their support systems around trustworthy, ethical, and open-source innovation in order to preserve monetization pathways and avoid the collapse of startup and SME ecosystems as public rejection grows. As a result, incubators and accelerators shift their focus to civic-technology, health technology, and digital commons. Meanwhile, investors reassess their positions, moving away from surveillance-oriented ventures, and directing capital towards privacy technologies, resilient infrastructure, health innovations, and ethical AI.

Additionally, private-sector solutions that rely on AI, surveillance, or data-heavy smart services encounter public backlash, regulatory tightening, and technology adoption barriers. In response, many firms redirect their efforts towards privacy-first platforms, decentralized data governance, and secure, locally anchored supply chains. The public sector is placed under immense pressure to manage an escalating health crisis, yet its efforts are constrained by persistent citizen resistance. Governments that pursue surveillance-heavy approaches face civil unrest and are compelled to adopt transparent, participatory, and citizen-led planning processes. Furthermore, civil society plays an increasingly influential role, stepping in to bridge trust gaps by acting as watchdogs, advocates, and co-creators of alternative models. Community-driven initiatives, digital rights movements, and local resilience networks become essential components of urban response systems.

Meanwhile, academia, anticipating this trajectory, expands research at the intersection of biosecurity, privacy, and governance. Interdisciplinary work, spanning public health, data ethics, urban design, and political science gains significance, and universities begin piloting community-trusted innovations through living labs.

5.4 Stress-testing the scenarios

Stress-testing strategic objectives across transformational and wildcard scenarios

The transformational and wildcard scenarios were mapped against the intended research outcomes and stress-tested to evaluate whether they align with core objectives to prioritize the desired scenario.

In the table on this page, a smiling-face emoji indicates a positive impact on an objective, a straight-face emoji indicates a neutral impact, and a sad-face emoji indicates a negative impact. The comparison shows that while each scenario has distinct strengths and weaknesses, one clearly emerges as the most desirable future, demonstrating strong alignment across all four objectives.

This mapping is also in line with the scenarios presented earlier. Although the four transformational scenarios may have appeared similar in ambition and design at first glance, three of them lacked critical pillars. Without these pillars, progress remains unpredictable, and over time the entire vision risks falling apart.

Table 3: Stress-testing the shortlisted scenarios against the objectives of the foresight study

Objective / Scenario	Objective 1: Inclusive and participatory urban futures	Objective 2: Affordable, accessible and resilient infrastructure	Objective 3: Local capacity and job creation	Objective 4: Sustainability and scalability	Objective 5: Technological innovation to transform smart cities
Safe zone					
Integrated-4QoL					
Shower of stars					
Open everything					
Pandemic refusal					

5.5 Enablers of the desired scenario

Factors that make open everything the desired scenario

The following enabling factors, along with their rationale and relevance to smart sustainable cities, provide a clear pathway for positioning smart cities as drivers of inclusive urban futures.

Government vision and leadership: Sets the direction for all stakeholders and aligns policies with quality-of-life (QoL) priorities. Good government vision and leadership ensures long-term planning, strategic coherence, and the delivery of health, well-being, and sustainable development outcomes.

Open, portable, and interoperable infrastructure: Enabled by open, portable standards and frameworks, interoperable technical and data infrastructure enables startups, SMEs and the private sector to build on shared platforms while protecting security and privacy. Open, portable, and interoperable infrastructure supports seamless integration of city energy, water, and transport systems, and encourages innovation without vendor lock-in.

Inclusive citizen engagement: Ensures that solutions reflect real needs and priorities, creating citizen ownership, trust, and relevance. Inclusive citizen engagement encourages co-design, improves adoption of sustainable solutions, and safeguards equity and accessibility.

Thriving entrepreneurship ecosystem: Drives innovation, fuels local economic growth, and generates diverse digital-green business models. A healthy entrepreneurship ecosystem supports agile problem-solving, community-led energy and water solutions, and maintains an active innovation pipeline.

Strategic private sector participation: Ensures adherence to open standards while bringing resources, expertise and ESG-driven motivation. Strategic private sector participation accelerates the delivery of infrastructure and services, ensuring that sustainability goals are commercially viable.

Active civil society advocacy: Acts as both watchdog and enabler, ensuring universal access, ethical AI use, and inclusion of informal economy actors. Active civil society advocacy protects equity, inclusivity, and human-rights principles in urban development, preventing marginalization.

Investor confidence and funding: This factor provides the capital needed to scale startups, citizen science initiatives, and SMEs, while reducing financial risk. Investor confidence and funding ensures long-term resources for sustainability projects, climate resilience initiatives, and smart city innovation.

Cross-sector and cross-border collaboration: This supports the adoption of best practices, accelerates innovation, and strengthens ecosystem resilience. Cross-sector and cross-border collaboration promotes global interoperability, scalable solutions, and well-informed policy frameworks for sustainable urban development.



6 Actioning the desired future

Shaping the future

This section marks the transition from foresight to strategy by translating the desired future into reality through an actionable agenda. It outlines the key interventions and strategic priorities needed to close the gap between the present conditions and the desired future.

A preliminary roadmap grounded in a shared understanding of stakeholder roles, the order of actions to be taken, and areas for coordination has been developed to guide implementation, setting the direction for proactive and inclusive changes in existing systems.

6.1 A roadmap to maturity

Building blocks of innovation-led growth

The actions recommended in this section are grounded in research insights and reflect the collective ambition to realize the desired open-everything vision, a scenario that is in line with the core objectives of this brief. Accordingly, the recommendations given to address systemic gaps along the entrepreneurial journey have been shaped by ecosystem consultations, expert inputs, and engagement with G20 members.

The recommendations are structured around six pillars that together provide a coherent roadmap for connected, inclusive, and sustainable economic growth powered by innovation. The first three pillars of innovation dynamics, innovation capacity, and innovation of key sectors provide the foundation for building the ecosystem, while the other three pillars of ecosystem research, ecosystem knowledge sharing, and ecosystem partnerships and governance play critical roles in leading the ecosystem towards maturity.

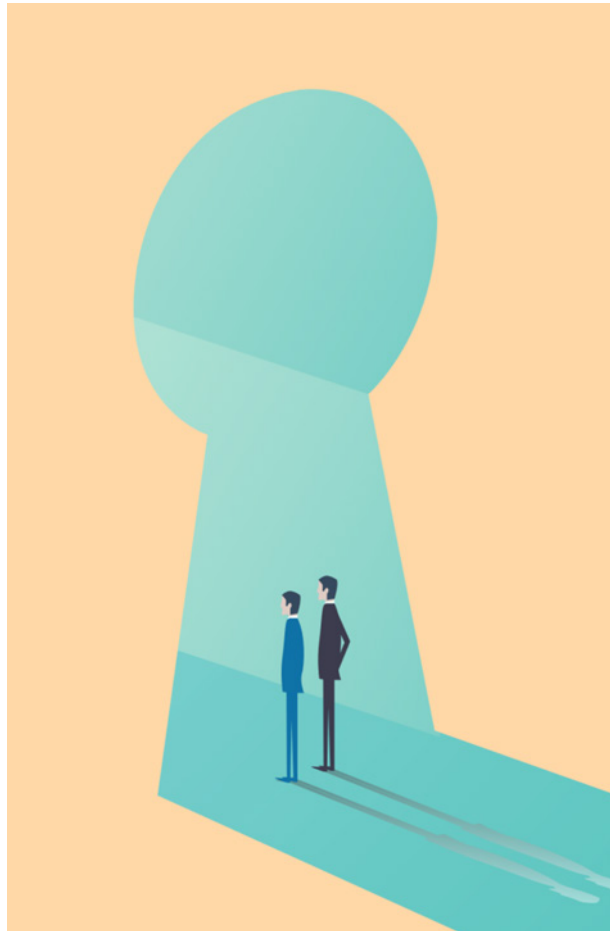


Figure 13: Six pillars of an integrated framework for action

Source: ITU

Together, these pillars form an integrated framework for action, although the pathways to implementation will naturally differ across countries. Domestic ecosystems vary when it comes to institutional readiness, resource availability, technological maturity, and governance capacity. As a result, governments and stakeholders may prioritize recommendations depending on local conditions while still moving in the collective long-term direction set out in this study.

The roadmap is therefore not meant to be linear or prescriptive. Rather, countries are encouraged to adapt and sequence actions in ways that best fit their domestic context, identifying appropriate champions across government, industry, finance, academia, support networks, and civil society. In doing so, each ecosystem can translate the overarching framework into tailored implementation plans and collaboration models that reflect local needs, all the while contributing to the shared vision of connected, inclusive, and sustainable smart cities and communities.

6.2 Actions to drive future-ready smart cities and communities

To translate the desired vision into tangible outcomes, the following roadmap is proposed. It encompasses a comprehensive set of interventions involving policy, capacity development, market activation, research, knowledge sharing, and collaboration, ensuring a coordinated and systemic approach to implementation.

Table 4: Proposed roadmap to realize the desired vision

Innovation dynamics (ID) <i>Actions that develop the policies and strategies supporting the creation, growth and competitiveness of smart sustainable cities</i>	Innovation capacity (IC) <i>Actions that strengthen the ability of smart sustainable cities to access, absorb and apply resources for innovation</i>	Innovation of key sectors (IKS) <i>Actions that drive innovation across sectors by enhancing the competitiveness of smart sustainable cities</i>
ID1: Embed QoL, universal access design, and climate resilience as core principles in developing integrated visions, policies, regulations, and strategies at both national and city levels.	IC1: Create programmes to fund and broker access to core infrastructure, including city-wide urban data platforms and green data centres.	IKS1: Invest in mobile-first digital infrastructure as a cross-sector enabler to expand inclusion of citizens and enterprises in informal settlements and economies.
ID2: Establish robust cybersecurity frameworks as a cornerstone of trust in smart city ecosystems.	IC2: Create data literacy programmes for government and public sector institutions to strengthen capacity to interpret data to make data-driven decisions aligned with regulations and ethics.	IKS2: Leverage public procurement to expand market access for local startups and SMEs, driving cross-sector innovation and competitiveness.
ID3: Establish open, portable standards for technical and data interoperability, and embed them in public sector procurement and contracting to ensure innovators, businesses, and public institutions can exchange and use data seamlessly.	IC3: Develop blended learning programmes to equip citizens and communities with the skills to navigate and benefit from their smart city, contribute to its development, and foster collective ownership.	IKS3: Create innovation investment clusters within innovation hubs and SEZs to channel capital flows and strengthen the skills of startups and SMEs for cross-sector collaboration and public-private partnerships.
ID4: Establish open regulatory sandboxes for innovations in energy, mobility, and data governance, accessible to both public sector leaders and private innovators to experiment, assess cross-sector impacts, and scale solutions.	IC4: Expand access to innovation spaces to strengthen capacity-building, mentorship, and opportunities for experimentation and collaboration.	IKS4: Develop cross-sector, QoL-focused Living Labs to test and commercialize x-as-a-service (XaaS) solutions.
ID5: Establish digital green twin cities to enable cross-departmental simulations of urban systems and support the scaling of innovations.	IC5: Collaborate across public, private, and academic institutions to develop curricula that build a talent pipeline equipped with emerging technology, digital skills, and sustainability skills aligned with future needs.	IKS5: Build sectoral value chains that integrate technology, regulation, finance, and human capital in healthtech, edtech, govtech, agritech, and urban sustainability.

Ecosystem research (ER) <i>Actions for initiatives that generate data and insights to guide policy, talent development and growth</i>	Ecosystem knowledge sharing (EKS) <i>Actions for platforms that enable the exchange of insights, data and learning to strengthen strategic alignment</i>	Ecosystem partnerships and governance (EPG) <i>Mechanisms that align capital, networks and governance to scale smart sustainable cities</i>
ER1: Collect, standardize, and analyse interoperable multi-sector city data to identify patterns across critical urban systems, generating actionable insights for policy and innovation.	EKS1: Implement real-time open data dashboards as urban knowledge platforms to share insights and data across all city stakeholders.	EPG1: Establish governance to coordinate policy, investment and innovation, supported by clear roles, accountability frameworks, and KPIs.
ER2: Conduct targeted research to assess the impact of involving local startups and SMEs in procurement and contracting, and identify gaps to inform policy and strategy responses.	EKS2: Organize structured multi-stakeholder learning networks as Urban Solution Labs to explore and co-create innovative solutions.	EPG2: Establish participatory governance mechanisms that engage citizens in oversight processes, strengthening legitimacy, trust, and inclusion.
ER3: Conduct assessments to map current and future skills needs across key sectors such as healthtech, edtech, energytech, climatech, govtech and mobility, to develop workforce planning, capacity-building, and lifelong learning programmes.	EKS3: Establish peer-to-peer learning platforms on PPPs to equip governments with best-practice procurement and contracting approaches for emerging technologies and AI.	EPG3: Facilitate investment frameworks that enable structured engagement between public and private investors to expand capital flows into high-impact PPP projects and startup and SME ecosystems, aligned with local and sectoral priorities and supported by milestone-based funding.
ER4: Conduct research on opportunities and risks of ethical AI and generative AI adoption.	EK4: Establish collaboration mechanisms to connect existing smart city pilots into coordinated constellations, fostering mutual learning and enabling access to central funding for shared initiatives.	EPG4: Encourage sector innovation partnerships with private sector, academia, civil society, and citizen technology hubs to drive long-term collaboration and shared use of resources, data, and expertise.
ER5: Test interventions in digital green twin cities to explore responses to policies, regulations, innovations, and disruptions, providing evidence to guide investment and decision-making.	EK5: Facilitate peer-to-peer learning through country-to-country and city-to-city networks, enabling the exchange of insights and best practices to strengthen collective capacity.	EPG5: Establish inter-agency regulatory committees to harmonize rules and standards and provide evidence-based input for policy development.



7 Managing the ecosystem

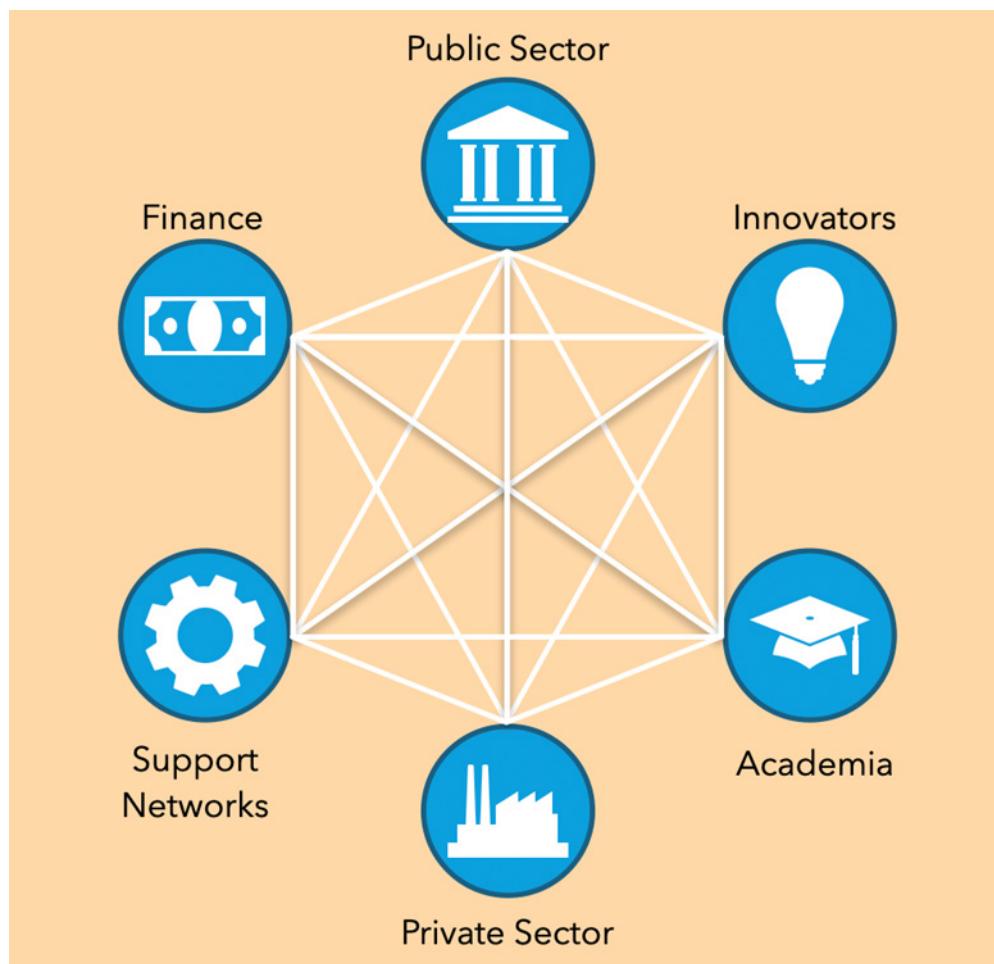
This section outlines structured mechanisms for providing guidance, supporting implementation, activating inclusive platforms, and enabling strategic partnerships and communication pathways, ensuring that the roadmap remains responsive, relevant, and ecosystem-driven over time.

7.1 Strength in stakeholder collaboration

An ecosystem approach to building future-ready smart sustainable cities and communities

Translating recommendations into lasting results requires a system in which diverse stakeholders not only participate but actively co-create, implement, and champion transformation. The realization of the desired future scenario depends on each stakeholder fulfilling a complementary role that collectively advances the creation of inclusive, future-ready smart sustainable cities and communities.

Figure 14: A well-connected ecosystem



Source: ITU

Governments and local authorities must set a strategic direction, establish policy and regulatory scaffolding, and oversee long-term implementation. Their role is to anticipate emerging technologies, embed ethical and sustainability standards, align procurement with openness, and ensure that public services reflect societal priorities and improve quality of life. Meanwhile, the private sector must co-develop solutions through transparent, standards-based partnerships. By building interoperable infrastructure, deploying scalable services, and prioritizing affordability and safety, private sector actors can help to strengthen city systems and expand equitable access.

Investors need to mobilize capital to support mission-aligned innovation. Public budgets must prioritize foundational services, while development finance, blended mechanisms and venture capital should be used to de-risk experimentation, accelerate adoption, and ensure sustainable financing for transformative initiatives.

Academia and research institutions must generate evidence and provide multidisciplinary expertise to build talent pipelines for a future-ready workforce. Their analysis informs policy, strengthens data governance and helps cities to adapt to emerging technological and environmental realities. Additionally, entrepreneurial support networks must cultivate a vibrant innovation ecosystem by providing training and mentoring to startups, SMEs, and citizen innovators enabling them to develop practical, context-specific solutions.

Civil society must safeguard citizen interests, uphold ethical standards and ensure that vulnerable groups are not excluded from the benefits of smart city. Through advocacy and community engagement, civil society helps maintain legitimacy, accountability and public trust.

Citizens themselves must be engaged as co-designers, contributors and decision-makers. Their participation and contributions help to determine priorities relating to privacy, sustainability, and community well-being, thereby ensuring that solutions remain relevant and legitimate.

Driving such an ambitious agenda requires more than just transactional engagement. It demands deliberate platforms and processes that bring these stakeholder groups together, fostering meaningful collaboration, and ensuring that diverse perspectives help shape decision-making and build trust.

7.2 Activating implementation mechanisms

Building processes and platforms for meaningful collaboration

Delivering on a shared vision requires not just defined roles, but also structured mechanisms that enable stakeholders to collaborate effectively over time. Platforms for engagement, transparent governance arrangements, catalytic partnerships, and open communication channels are essential to translate strategic intent into coordinated action. By institutionalizing inclusive processes and feedback loops, ecosystems can sustain momentum, strengthen trust, and ensure that implementation remains adaptive, accountable, and aligned with long-term objectives.

Table 5: Platforms and structured mechanisms for stakeholder collaboration

CHAMPIONS FOR SHARED OWNERSHIP		
Mobilizing champions is essential to anchor ownership and embed QoL and inclusivity in smart sustainable cities. These champions should emerge from across local stakeholder groups, including city mayors, IoT strategy directors, sustainability departments, city planners, transport authorities, utilities and energy cooperatives, civic-technology hubs, R&D universities, entrepreneurship ecosystem builders, civil society, and citizen and community associations, alongside private-sector innovators and investors. Engagement must operate at local, regional, and national levels through mechanisms such as multi-agency working groups, public consultations, and open innovation challenges to identify priorities, foster alignment, and build shared responsibility for solutions. Embedding feedback and accountability loops ensures stakeholder perspectives guide implementation and ongoing adaptation.		
GOVERNANCE FOR TRUST AND ACCOUNTABILITY	PARTNERSHIPS FOR CATALYTIC ENGAGEMENT	COMMUNITY FOR SHARED LEARNING
In the interconnected landscape of smart sustainable cities, trust depends on transparent, inclusive, and accountable governance. A dedicated multistakeholder governance body should be established, bringing together representatives from local government, city planning and sustainability departments, public transport and utility authorities, telecommunication providers, B2B manufacturers of smart-city infrastructure, R&D universities, civil society advocacy groups, and innovation hubs. Its mandate is to embed equity in decision-making and policy oversight through inclusive practices. The formation of the dedicated multistakeholder governance body should be supported by structured consultations, co-design workshops, and pilot initiatives that build legitimacy, strengthen shared ownership, and secure long-term commitment.	Catalytic partnerships are crucial for mobilizing resources, accelerating knowledge transfer, and scaling innovation in smart sustainable cities. Local government councils, planning and sustainability departments, public utilities, private-sector actors and telecommunication companies, investors, R&D universities, innovation hubs, and community-owned technology spaces must align around shared objectives, such as e-learning, smart energy, mobility, e-government, healthcare, and climate resilience, to coordinate priorities and amplify impact. These partnerships should be built on co-investment, policy co-creation, and ecosystem development, initiated through thematic roundtables, sectoral working groups, and co-design workshops to activate robust, purpose-driven, and mutually beneficial alliances.	Smart sustainable cities flourish when knowledge circulates freely and when successes are shared, challenges addressed collectively, and effective models are scaled. A dedicated smart-living learning community can bridge information gaps, elevate diverse voices, and strengthen trust. It should bring together local government leaders, city planners, sustainability and public-service departments, private-sector actors and telecommunication companies, R&D universities, innovation hubs, citizen associations, and hyper-local tech hubs to exchange urban data, share lessons learned, and engage in peer-to-peer learning on local challenges, transforming insights into accessible e-learning resources. Community expertise must be valued with meaningful experiences and reciprocal support to ensure sustained engagement.
COMMUNICATING AND ADVOCATING FOR IMPACT		
Strategic communication is vital to position smart sustainable cities as inclusive, resilient, and future-ready. Effective advocacy shifts narratives, mobilizes political will, and builds confidence among citizens, investors, and policy-makers. Local ecosystem actors should jointly shape a compelling communication strategy that highlights sustainability milestones, digital infrastructure achievements, citizen-science innovations, and cross-sector breakthroughs across both urban and rural communities. Target audiences include government leaders, planners, utilities, private sector, telecommunication companies, R&D universities, innovation hubs, and citizen associations. Channels may span city summits, social media, participatory assemblies, and global forums, using accessible storytelling and clear feedback loops to ensure transparency and trust.		



Annex

Global best practices

Sponge City initiative (China)

China's Sponge City initiative reimagines urban water management through nature-based and permeable infrastructure that absorbs, stores, and reuses rainwater to reduce flooding and improve water quality. Launched in 2015 across pilot cities, including Wuhan, Xiamen, and Shenzhen, the programme integrates green roofs, permeable pavements, wetlands, and rain gardens into urban design. These interventions help cities withstand extreme rainfall, replenish groundwater, and enhance urban liveability.

Urban greening (Denmark)

An urban greening initiative in Copenhagen uses nature-based solutions to enhance climate resilience, biodiversity, and citizen well-being. Urban projects such as Sankt Kjelds Square and Bryggervangen have transformed grey urban areas into vibrant green spaces. The Green Roof Policy mandates greenery on new municipal buildings, enhancing biodiversity and supporting climate adaptation. These efforts contribute to municipal goal of carbon neutrality by 2025, and position the city as a model for sustainable urban development.

Open data initiative (Mexico)

Launched in 2019 by the Digital Agency for Public Innovation, the open data policy initiative of Mexico City democratizes access to municipal data through the *Portal de Datos Abiertos*. Equipped with an interactive visualization tool, the portal enables citizens, developers, and researchers to analyse and utilize government data. This initiative has supported a 53 per cent reduction in high-impact crime by enabling data-driven security solutions.

Participatory mapping and data collection (Republic of Indonesia)

The non-profit organization *Kota Kita* (Our city) empowers Solo city residents through participatory mapping and data collection, producing 'mini-atlases' that inform the *Musrenbang* participatory planning and budgeting process. These tools enable communities to advocate for infrastructure improvements, ensuring that urban planning aligns with local needs and strengthening inclusive data-driven decision-making processes. This approach enhances civic engagement and urban resilience.

City Living Lab (Republic of India)

The Smart City Living Lab at the International Institute of Information Technology, Hyderabad accelerates smart city innovation by providing open access to real-time urban data via the Indian Urban Data Exchange (IUDX). This initiative promotes data-driven decision-making, enabling stakeholders to develop cross-sectoral solutions in areas such as air quality, energy, water, and mobility, thereby advancing sustainable urban development.

Participatory Futures initiative (Republic of South Africa)

The 2025 Participatory Futures initiative at Wits University in Westbury, Johannesburg, clearly demonstrates that smart city solutions should be co-designed with resident participation. Through Participatory Futures workshops, community members envisioned technologies that enhance safety, culture, and sustainability. Their involvement and input ensures that technological interventions remain locally relevant, trusted, and aligned with community values.

Digital governance model (Estonia)

The digital governance model employed in Estonia and exemplified in cities such as Tallinn, Tartu, and Pärnu, integrates advanced technologies to enhance urban living. Initiatives including e-Residency, the X-Road data exchange platform, and e-ID cards ensure secure online services such as e-voting, digital healthcare, and participatory budgeting. These efforts streamline public services, promote transparency, and foster citizen engagement in urban development.

Vendor neutral specifications (United Arab Emirates)

The Open and Agile Smart Cities (OASC) initiative in the United Arab Emirates adopts minimal interoperability mechanisms (MIMs) to provide practical, vendor-neutral specifications that ensure data portability and scalability across urban systems. This approach allows cities to implement interoperable, flexible smart city solutions, thereby fostering innovation, reducing vendor lock-in, and supporting the delivery of efficient, scalable, and citizen-centred urban e-services.

Smart city charter (Federative Republic of Brazil)

The smart city charter employed in Rio de Janeiro offers an exemplar of smart city leadership, guiding urban digital transformation through a democratic policy framework. The charter establishes a public agenda for inclusive, sustainable, and technology-driven development, fostering citizen participation, transparency, and innovation, and aligning policies to promote efficient, equitable, and future-ready urban governance.

Dubai paperless strategy (United Arab Emirates)

Dubai city council has implemented a city-wide paperless strategy alongside the DubaiNow super-app, which has created a unified digital interface for government services. This initiative has transformed the delivery and accessibility of public services by integrating multiple public entities and streamlining processes for citizens.

Abbreviations

Abbreviation	Full form
5G	Fifth generation (wireless communication standards)
AI	Artificial intelligence
AQI	Air quality index
B2B	Business to business
ESG	Environmental, social and governance
ICT	Information and communication technology
IoT	Internet of Things
IP	Intellectual property
PPP	Public-private partnership
QoL	Quality of life
QALY	Quality-adjusted life year
SEZ	Special economic zone
SMEs	Small and medium enterprises

Glossary

Term	Definition
Air quality index (AQI)	The Air Quality Index (AQI) is a standardized numerical scale that indicates the level of air pollution and its potential health impacts on humans.
Business to business (B2B)	Businesses that produce products or services intended for other businesses rather than directly for individual consumers.
Citizen science/scientist	Where citizens use open-source sensors and IoT to collect, analyse and share data to inform public and private sector stakeholders, improve decision-making and enhance the quality of life. Particularly used in environmental monitoring.
Critical issues analysis	A cross-disciplinary method of ranking the issues most likely to shape sustainable innovation. Mixing creative workshops, expert panels, evidence reviews, and stakeholder dialogue, it scores each driver by its impact and uncertainty using the STEEPLE approach (social, technological, economic, environmental, political, legal, and ethical).
Desired scenario	The most desirable future outcome, based on stakeholder values, aspirations, and strategic priorities.
Drivers	The key forces or underlying factors that influence or shape change within a system. Drivers may be internal or external, and they can feature economic, technological, political, environmental, or social aspects. They often interact and evolve over time, shaping future scenarios.
Environment, social, governance (ESG)	A framework for evaluating the sustainability and ethical impact of an organization, considering its environmental practices, social responsibility, and governance structures to guide investment, management, and policy decisions.
Futures thinking	The mindset and practice of considering multiple plausible futures to anticipate change and guide proactive action in the present.
Innovation ecosystem	A dynamic network of institutions, stakeholders, policies, and technologies that collectively enable innovation, collaboration, and systemic transformation.
Mega driver	A cluster of interrelated drivers that collectively exert a larger, systemic influence on change within a system. Mega drivers are broader in scope, cutting across sectors and domains, and represent overarching forces that shape and accelerate the trajectory of multiple underlying drivers.
Payment for ecosystem services scheme (PES Scheme)	Participants receive financial incentives for managing natural resources in ways that provide ecological benefits, such as clean water, carbon sequestration, or biodiversity conservation.
Public-private partnership (PPP)	A formal arrangement in which a government and one or more private-sector organizations collaborate to finance, build, operate or deliver public infrastructure or services.

Term	Definition
Quality of life (QoL)	The overall well-being of individuals and communities, encompassing material living conditions, health, education, safety, environmental quality, social belonging, and opportunities for personal fulfilment. It reflects how well people are able to live, work, participate, and thrive in their environments.
Quality-adjusted life year (QALY)	A standard measure used in health economics to assess the value of medical interventions. It combines both the length of life and the quality of health during that life into a single metric.
Scenario	A narrative or model that describes a plausible future state based on drivers and uncertainties.
Special economic zone (SEZ)	A designated area within a country that operates under different economic regulations and incentives to attract investment, promote trade, and boost industrial or commercial activity.
Signals	Early indicators or weak signs of change that may point to emerging trends, disruptions, or innovations in their early stages.
Small and medium enterprises (SME)	Businesses with limited staff and revenue that contribute significantly to local employment and local economic growth.
Sovereign cloud	Cloud infrastructure and services that comply with the data sovereignty rules of a specific country or region.
Sovereign cloud backbone	This is the underlying cloud infrastructure built to ensure that sensitive data is stored and processed within a country's borders, under their legal jurisdiction— often operated by local providers, or by big cloud vendors in partnership with local entities.
Stakeholder engagement	A participatory process of involving key actors in shaping decisions, aligning efforts, and ensuring the shared ownership of outcomes.
Startup	A recently launched business venture focused on innovation and scalable growth that frequently leverages technology to disrupt existing markets or create new ones.
Strategic foresight	A structured approach to exploring possible futures by identifying trends, drivers, uncertainties, and opportunities to inform long-term decision-making and strategy.
Transformation pathways	Strategic routes or sequences of actions taken to move from current conditions towards a preferred future scenario.
Trends	Patterns of change that have already gained momentum and may continue to shape the future over time.

Term	Definition
Weak signals	Early signs of potentially important changes that are not yet widely recognized or understood. Weak signals may indicate the emergence of new trends, disruptions, or innovations, and they are often detected on the margins of mainstream awareness.
Wildcards	Low-probability, high-impact events or developments that could significantly disrupt current trajectories.

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Office of the Director
International Telecommunication Union (ITU)
Telecommunication Development Bureau (BDT)
Place des Nations
CH-1211 Geneva 20
Switzerland

Email: bdtdirector@itu.int
Tel.: +41 22 730 5035/5435

Office of the Deputy Director
Operations Coordination Department (DDR)
Place des Nations
CH-1211 Geneva 20
Switzerland

Email: bdtdeputydir@itu.int
Tel.: +41 22 730 5131

**Digital Networks and Environment
Department (DNE)**

Email: bdt-dne@itu.int
Tel.: +41 22 730 5421

**Digital Knowledge Society
Department (DKS)**

Email: bdt-dks@itu.int
Tel.: +41 22 730 5900

**Projects, Partnerships and Digital
Skills Department (PPS)**

Email: bdt-pps@itu.int
Tel.: +41 22 730 5447

Africa

Ethiopia

**International Telecommunication
Union (ITU) Regional Office**
Gambia Road
Leghar Ethio Telecom Bldg. 3rd floor
P.O. Box 60 005
Addis Ababa
Ethiopia

Email: itu-ro-africa@itu.int
Tel.: +251 11 551 4977
Tel.: +251 11 551 4855
Tel.: +251 11 551 8328
Fax: +251 11 551 7299

Cameroon

**Union internationale des
télécommunications (UIT)**
Bureau de zone
Immeuble CAMPOST, 3^e étage
Boulevard du 20 mai
Boîte postale 11017
Yaoundé
Cameroon

Email: itu-yaounde@itu.int
Tel.: +237 22 22 9292
Tel.: +237 22 22 9291
Fax: +237 22 22 9297

Senegal

**Union internationale des
télécommunications (UIT)**
Bureau de zone
8, Route du Méridien Président
Immeuble Rokhaya, 3^e étage
Boîte postale 29471
Dakar - Yoff
Senegal

Email: itu-dakar@itu.int
Tel.: +221 33 859 7010
Tel.: +221 33 859 7021
Fax: +221 33 868 6386

Zimbabwe

**International Telecommunication
Union (ITU) Area Office**
USAF POTRAZ Building
877 Endeavour Crescent
Mount Pleasant Business Park
Harare
Zimbabwe

Email: itu-harare@itu.int
Tel.: +263 242 369015
Tel.: +263 242 369016

Americas

Brazil

**União Internacional de
Telecomunicações (UIT)**
Escritório Regional
SAUS Quadra 6 Ed. Luis Eduardo
Magalhães,
Bloco "E", 10^o andar, Ala Sul
(Anatel)
CEP 70070-940 Brasília - DF
Brazil

Email: itubrasilia@itu.int
Tel.: +55 61 2312 2730-1
Tel.: +55 61 2312 2733-5
Fax: +55 61 2312 2738

Barbados

**International Telecommunication
Union (ITU) Area Office**
United Nations House
Marine Gardens
Hastings, Christ Church
P.O. Box 1047
Bridgetown
Barbados

Email: itubridgetown@itu.int
Tel.: +1 246 431 0343
Fax: +1 246 437 7403

Chile

**Unión Internacional de
Telecomunicaciones (UIT)**
Oficina de Representación de Área
Merced 753, Piso 4
Santiago de Chile
Chile

Email: itusantiago@itu.int
Tel.: +56 2 632 6134/6147
Fax: +56 2 632 6154

Honduras

**Unión Internacional de
Telecomunicaciones (UIT)**
Oficina de Representación de Área
Colonia Altos de Miramontes
Calle principal, Edificio No. 1583
Frente a Santos y Cia
Apartado Postal 976
Tegucigalpa
Honduras

Email: itutegucigalpa@itu.int
Tel.: +504 2235 5470
Fax: +504 2235 5471

Arab States

Egypt

**International Telecommunication
Union (ITU) Regional Office**
Smart Village, Building B 147,
3rd floor
Km 28 Cairo
Alexandria Desert Road
Giza Governorate
Cairo
Egypt

Email: itu-ro-arabstates@itu.int
Tel.: +202 3537 1777
Fax: +202 3537 1888

Asia-Pacific

Thailand

**International Telecommunication
Union (ITU) Regional Office**
4th floor NBTC Region 1 Building
101 Chaengwattana Road
Laksi,
Bangkok 10210,
Thailand

Email: itu-ro-asiapacific@itu.int
Tel.: +66 2 575 0055

Indonesia

**International Telecommunication
Union (ITU) Area Office**
Gedung Sapta Pesona
13th floor
Jalan Medan Merdeka Barat No. 17
Jakarta 10110
Indonesia

Email: bdt-ao-jakarta@itu.int
Tel.: +62 21 380 2322

India

**International Telecommunication
Union (ITU) Area Office and Innovation
Centre**
C-DOT Campus
Mandi Road
Chhatarpur, Mehrauli
New Delhi 110030
India

Email: itu-ao-southasia@itu.int
Area Office: itu-ao-southasia@itu.int
Innovation
Centre: itu-ic-southasia@itu.int
Website: ITU Innovation Centre in
New Delhi, India

CIS

Russian Federation
**International Telecommunication
Union (ITU) Regional Office**
4, Building 1
Sergiy Radonezhsky Str.
Moscow 105120
Russian Federation
Email: itu-ro-cis@itu.int
Tel.: +7 495 926 6070

Europe

Switzerland

**International Telecommunication
Union (ITU) Office for Europe**
Place des Nations
CH-1211 Geneva 20
Switzerland

Email: euregion@itu.int
Tel.: +41 22 730 5467

International Telecommunication Union
Telecommunication Development Bureau
Place des Nations
CH-1211 Geneva 20
Switzerland

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