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ASTANA INTERNATIONAL FINANCIAL CENTRE

The Next Wave Of Urban Development: **Investing In Smart City Infrastructure And Technology**

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The Next
Wave Of Urban Development:
Investing In Smart City Infrastructure And Technology

Foreword

From The Governor Of The Astana International Financial Center

Dear Readers,

I am pleased to present the report “The Next Wave of Urban Development: Investing in Smart City Infrastructure And Technology” prepared by the Astana International Financial Centre (AIFC).

Around the world, cities are undergoing profound change — evolving from traditional administrative centers into data-driven, connected ecosystems that integrate technology, sustainability, and human-centered governance.

Kazakhstan is part of this global transformation. Over the past decade, the country has moved from isolated pilot projects to a structured national framework where digitalization, analytics, and institutional reform converge to make cities more efficient, resilient, and inclusive.

This report provides a comprehensive overview of Kazakhstan’s smart-city journey — from global benchmarks and policy evolution to local implementation and investment opportunities. It highlights how digital infrastructure, artificial intelligence, and the Internet of Things (IoT) are reshaping service delivery, urban management, and citizen engagement across the country’s leading cities.

At the AIFC, we believe that smart cities are not only about technology, but about governance, trust, and measurable outcomes. By providing a transparent legal framework based on English common law, advanced digital finance tools, and a collaborative innovation ecosystem, the AIFC stands ready to catalyze investment into the next generation of Kazakhstan’s urban development.

We issue this report as an accessible guide for investors, policymakers, and urban leaders examining Kazakhstan’s emerging smart-city and digital urban development agenda.

Sincerely,
Renat Bekturov

LIST OF ABBREVIATIONS

ACA	Alatau City Authority
ADB	Asian Development Bank
AED	Arab Emirates Dirham
AFSA	Astana Financial Services Authority
AI	Artificial Intelligence
AI Verify	Artificial Intelligence Verify Framework
AIFC	Astana International Financial Centre
API	Application Programming Interface
ASC	Amsterdam Smart City
B2G	Business-to-Government
BEMS	Building Energy Management System
BPMN	Business Process Model and Notation
CAGR	Compound Annual Growth Rate
CDA	Country Digital Acceleration
CDTO	Chief Digital Transformation Officer
CHF	Swiss Franc
CML	Customer Minutes Lost
CO2	Carbon Dioxide
CSCEC	China State Construction Engineering Corporation
CSL	Copenhagen Solutions Lab
CSO	Civil Society Organization
CTS	City Transportation Systems
DEWA	Dubai Electricity and Water Authority
DFI	Development finance institutions
DIC	Dubai Internet City
DIFC	Dubai International Financial Centre
EBRD	European Bank for Reconstruction and Development
EGDI	E-Government Development Index
eGov	Electronic Government
EIB	European Investment Bank
ESG	Environmental, Social, and Governance
EV	Electric Vehicle
GDS	Global Destination Sustainability
GFI	Green Finance Institute
GGGI	Global Green Growth Institute
GIS	Geographical Information Systems
GoA4	Grade of Automation 4
GPON	Gigabit Passive Optical Network
GSCP	Global Smart City Partnership
HPC	High-Performance Computing
IAC	International Arbitration Centre
IBM	International Business Machines Corporation
ICMA	International Capital Market Association
ICT	Information and Communication Technologies
IFC	International Finance Corporation
IMD	International Institute for Management Development
InvITs	Infrastructure Investment Trusts
InvIT	Infrastructure investment trusts
IOC	Intelligent Operation Center
IoT	Internet of Things
ISSAI	Institute of Smart Systems and Artificial Intelligence
KPI	Key Performance Indicator
KZT	Kazakhstani tenge
LRT	Light Rail Transit
MaaS	Mobility-as-a-Service
MSW	Municipal Solid Waste
OECD	Organisation for Economic Co-operation and Development
P4P	Pay for Performance
PPI	Public Procurement of Innovation
PPP	Public–Private Partnership
PSIM	Physical Security Information Management
ROI	Return on Investment
RTA	Roads and Transport Authority
SCA	Smart City Accelerator
SCI	Smart Centres Index
SDG	Sustainable Development Goals
SDU	Smart Data Ukimet
SEZ	Special Economic Zone
SME	Simple and Medium Enterprise
SNDGO	Smart Nation and Digital Government Office
SNSP	Smart Nation Sensor Platform
SPS	Smart Police Stations
SPV	Special Purpose Vehicle
TeSA	TechSkills Accelerator
UAV	Unmanned Aerial Vehicle
UGV	Unmanned Ground Vehicle
UN	United Nations
UNDP	United Nations Development Programme
UN-Habitat	United Nations Human Settlements Programme
USD	United States Dollar
USV	Unmanned Surface Vehicle
UU	Unmanned Underwater Vehicle
V2G	Vehicle-to-Grid
ZVV	Zürcher Verkehrsverbund

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Contents

1. EXECUTIVE SUMMARY 12

Why Smart Cities Matter 14
Kazakhstan: From Strategy to Implementation 16

2. THE EVOLUTION OF SMART CITIES: FROM TECHNOLOGY SILOS TO INTEGRATED SYSTEMS 20

2.1 Urbanization as a Catalyst: How Global Growth Forced Cities to Innovate 22
2.2 From Digital Cities to Citizen-Centric Ecosystems: A Historical Timeline 24
2.3 The Three Generations of Smart Cities: 1.0, 2.0, and 3.0 26
2.4 Towards Integrated, Adaptive, and Resilient Urban Ecosystems 32

3. THE GLOBAL LANDSCAPE: LESSONS FROM PIONEERS AND PITFALLS 40

3.1 The Digital Backbone of Urban Transformation 42
3.2 Global Leaders: Benchmarking Success Stories 50
3.2.1 Zurich: Sustainability by Design and Data-Driven Governance 52
3.2.2 Singapore – From Data Islands to a Nation-as-a-Platform 58
3.2.3 Seoul – A Citizen-Centric Model of Digital Governance 64
3.2.4 Copenhagen – Climate-Smart Digital Transformation 70
3.2.5 Dubai – Data-Driven Governance at Scale 76
3.2.6 Abu Dhabi – AI-Native Governance and Sustainable Urban Innovation 82
3.2.7 Amsterdam: From Pilot Projects to Citizen-Centric Urban Innovation 88
3.3 Common Pitfalls and Lessons Learned 94

4. KAZAKHSTAN'S SMART CITY TRANSFORMATION: FROM DIGITAL POLICY TO IMPLEMENTATION 100

4.1 Urbanization Trends and City Challenges in Kazakhstan 102
4.1.1 Urbanization Trends 102
4.1.2 Urban Population Growth and Megacity Expansion 106
4.1.3 Urban Digital Transformation Challenges and Constraints 108
4.2 Digital Transformation and Urban Strategy 110
4.3 Digital Services and Citizen Platforms: Everyday Smart Living 112
4.4 National Smart-City Methodology: What It Is, How It Works, Why It Matters 114
4.5 What Works Where: Comparative Readout on Astana, Almaty, and Regional Initiatives 116
4.5.1. Kazakhstan Smart City ranking 118
4.5.2. Astana 120
4.5.3. Almaty 128
4.5.4 Other cities' measures to keep up 132
4.6 Academic and Research Partnership 134
4.7 Innovation Ecosystem and Business Incubators 136
4.8 Alatau City: Kazakhstan's Born-Digital Urban Hub 140

5. FINANCING THE FUTURE CITY: NEW MODELS FOR URBAN INVESTMENT 148

5.1 Redefining urban finance: the current investment landscape 150
5.2 Catalyzing private capital: innovative financing mechanisms 154
5.3 Connecting Markets and Cities: The Role Of Capital Hubs 162

Executive Summary

In recent years, Kazakhstan's smart-city agenda has shifted from pilot projects to integrated, outcome-driven operating systems. National digital maturity, standardized KPIs, and platform contracts are turning data into daily service improvements – mobility, safety, utilities, payments, and inclusion – while creating structures that can draw private capital.

This Report offers a comprehensive view of the global smart-city market and Kazakhstan's position within it – covering operating models (IoT–5G–AI, situation centers, digital twins), governance and interoperability, financing architectures, and city case studies.

Key findings

Urbanization is reshaping the global economy

By 2050, nearly 68% of the world's population will live in cities, making urban efficiency, sustainability, and digital readiness key determinants of national competitiveness. Cities are becoming engines of growth — but also the front line for climate action, infrastructure demand, and social inclusion

Countries are shifting from isolated technologies to fully integrated city systems

Global smart-city leaders show that progress is no longer about deploying more devices. Success depends on strong governance, interoperable data platforms, and sustainable financing — enabling cities to move from small pilots to connected, citywide systems that deliver measurable results

Kazakhstan's Smart City transformation reaches a defining stage

Rapid urbanization, especially in Astana, Almaty, and Shymkent, is driving demand for smarter mobility, utilities, and citizen services. The focus has shifted from digital pilots to platform-scale implementation, aligning cities, ministries, and investors around measurable performance and shared infrastructure

Why Smart Cities Matter

The digital transformation of cities has become one of the defining forces shaping the 21st century. Around the world, urban areas are evolving from traditional administrative centers into interconnected ecosystems powered by data, technology, and innovation. Yet, this transformation remains uneven. **Today, an estimated 2.6 billion people still lack affordable access to the internet, and 39 percent of the global population do not use it even where connectivity exists[1].** Adoption gaps remain especially wide in rural areas, low-income countries, and among women, reflecting persistent social and economic divides. Within cities, the digital gap is also visible between and within communities, limiting equal access to opportunities and deepening inequality.

At the institutional level, engagement and participation lag behind technological progress. **More than half of local authorities worldwide report difficulties engaging communities in digital initiatives, and only one in five residents actively participates in smart-city projects.[1]** These figures underscore a crucial reality – technology alone does not guarantee inclusiveness. Without meaningful participation and equitable access, digital transformation risks reinforcing – rather than reducing – social and economic divides.

Despite these challenges, **cities remain the engines of global development, generating roughly 80% of global GDP.**[2] As urbanization accelerates, their significance only increases - **the share of the world's population living in urban areas is projected to rise from 57% in 2023 to 68% by 2050.**[3] Yet, cities are also at the center of many global challenges. **They account for roughly 75% of global CO2 emissions, driven largely by transport and buildings, and the top largest 25 cities alone contribute more than half (52%) of total urban greenhouse gas emissions**.[4]

This dual reality positions cities as both drivers of prosperity and front lines in the process of tackling climate change. Reconciling growth with sustainability has made technology-enabled transformation essential to building cities that are more efficient, inclusive, and livable. Urban areas are now the largest consumers of digital and smart infrastructure worldwide, fueling a rapidly expanding global smart-city market and redefining how growth, sustainability, and resilience intersect in the modern age.

In this context, the smart city model has become a central framework for achieving sustainable urban development. According to the International Telecommunication Union, "A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects." At its core, the model emphasizes the use of ICTs, the Internet of Things (IoT), and data-driven systems to monitor and integrate urban functions, while prioritizing sustainability, human capital, and environmental stewardship.

[1] UN-Habitat, International Guidelines on People-Centred Smart Cities (2025)
[2] Urban Development Overview-World Bank Group
[3] UN-Habitat, World Smart Cities Outlook 2024
[4] Frontiers in Sustainable Cities (2021). "Keeping Track of GHG Reduction Progress in 167 Cities."

Ultimately, this definition signals a crucial shift: success in smart cities is not measured by the adoption of technology alone, but by how effectively technology improves processes, outcomes, and resilience. This holistic strategy is anchored in six interdependent pillars – **1) smart economy 2) smart government, 3) smart environment, 4) smart people, 5) smart living, and 6) smart mobility** – whose coordinated implementation is fundamental to building competitive, adaptive, and future-ready urban ecosystems (see Figure 1).

Figure 1

Key Pillars of Smart City

Source: Giffinger et al., Vienna University of Technology (2007)

These pillars provide structural logic for integrating technology and sustainability across all layers of urban management. Smart government advances transparency, e-governance, and efficient public services. Smart economy fosters productivity, innovation, and sustainable employment. Smart environment promotes sustainable resource management and green infrastructure. Smart people focus on inclusivity, creativity, and digital skills. Smart living enhances quality of life and public safety, while smart mobility ensures green, efficient, and multimodal transport systems. Together, these elements form a conceptual model for next-generation urban development – one that views the city as a dynamic ecosystem rather than a collection of disconnected technologies or sectors.

Kazakhstan: From Strategy to Implementation

Kazakhstan has moved decisively to translate the smart city paradigm into a national strategic priority. Initiatives like the “Digital Kazakhstan” program have established a strong foundation, contributing to the country’s rise in the UN E-Government Development Index, where it now ranks 24th globally, the highest among Central Asian nations.[5]

This commitment was recently reinforced at the highest level, setting the full-scale integration of AI and smart technologies as a national priority. A key strategic announcement was the designation of Alatau City as the nation’s first fully digital city, underscoring a clear commitment to creating a future-ready urban model.

This top-down strategic direction is being complemented by concrete implementation across major urban centers. Cities such as Almaty have deployed smart traffic management systems, while Karaganda is leveraging AI for road quality monitoring.

The capital, Astana, serves as a prime example of this progress, achieving international recognition with its inclusion in the 2025 IMD Smart City Index (102nd globally out of 146 cities)[6] and its 46th place in the Smart Centres Index (SCI)[7]. These rankings attest to the city’s effective integration of technology and its commitment to improving the quality of urban life.

102/ 146

2025 IMD Smart City Index

46/ 76

Smart Centres Index (SCI)

International partnerships are accelerating this momentum. The UAE-based company Presight AI has launched a USD $190 million[8] collaboration with the city administration of Astana (Akimat of Astana) to enhance public safety through advanced analytics and AI-driven surveillance. These investments underline Kazakhstan’s growing attractiveness as a regional hub for smart-city innovation.

The development of smart cities is no longer a technological trend but a fundamental requirement for sustainable urban development. For Kazakhstan, this framework is critical for managing urban pressures and represents a significant opportunity for stakeholders investing in next-generation urban solutions.

5 E-Government Survey 2024
6 IMD – Smart City Index 2025
7 Z/Yen – The Smart Centres Index 11

8 Presight’s official website: City of Astana partners with Presight for AI-powered smart city project

BIGVILLE: A PEOPLE-CENTRIC SMART DISTRICT

30 years shaping Kazakhstan's development landscape

630 000+ residents living in BI-built neighborhoods

Projects across **up to 8 countries**

200+ completed projects

As the largest developer in Central Asia, BI Group plays a defining role in shaping Kazakhstan's urban future. Beyond delivering housing, the company builds integrated districts, modern infrastructure, and digitally enabled environments that align with global Smart City standards.

Bigville — BI Group's flagship ecosystem district — illustrates how construction, digital services, and urban planning can converge into a seamless, technology-driven living model in megacities, supporting a polycentric urban structure where multiple centers of life and activity coexist.

- Everything important close to home
- Safe, pleasant spaces for families
- Easy access to daily essentials
- A calm convenient, time-saving lifestyle

Bigville is more than a development — it is a scalable model for how modern cities across Central Asia can evolve

*Image shown for illustrative purposes: rendered visualization of the Bigville Nexpo project in Astana

BI GROUP

In Smart Cities, technology matters – but comfort comes first

Bigville is built around the idea that everything residents need should be within a 5-, 10-, or 15-minute walk:

5 minutes — everything essential nearby

10 minutes — everything you need within reach

15 minutes — everything you love within your neighborhood

BI Group Digital Ecosystem

BI Group integrates technology across the entire project lifecycle — from **BIM (Building Information Modeling) and sensor-based monitoring to resident services** — enhancing accuracy and efficiency

Digital Comfort Through BIG App

BIG App streamlines daily life: service requests, updates and payments– all in one place. With **250 000+ users** and **100% digital** client journey, **BIG App** enhances everyday residents' comfort.

The essence of the Bigville is simple: cities are meant to be built around people — where comfort, safety, and everyday ease define urban life.

BIG Invest — Explore BI Group's Opportunities

From landmark residential projects to commercial and international opportunities, BIG Invest provides access to investments built for stability and long-term growth

Scan the QR code to discover current opportunities

The Evolution Of Smart Cities: **From Technology Silos To Integrated Systems**

Key findings

Integration Drives Impact

Technology alone does not create smart cities - cross-functional alignment and shared data architecture do. Breaking organizational silos is the foundation of scalable intelligence

Ecosystem over Hardware

Leading cities move beyond deploying devices to orchestrating connected ecosystems where data, talent, and governance deliver measurable outcomes

From Pilots to Platform

Success lies in scaling proven solutions through integrated frameworks that embed innovation into the city's core operating model

2.0

Section Summary:

The concept of the 'smart city' is not a recent invention but the culmination of a decades-long evolution in thinking about the intersection of technology, data, and urban life. Its origins trace back to early computational urban analysis in the 1970s and the 'Digital City' initiatives of the 1990s, before the term was popularized by major technology corporations in the 2000s.[9]

The strategic approach has matured through distinct generations: from a technology-driven 'Smart City 1.0', to a government-led '2.0', and now towards a citizen co-created '3.0'.

This progression has been enabled by key technological milestones – the synergistic combination of the Internet of Things (IoT) as the city's sensory network, 5G as its high-speed circulatory system, and Artificial Intelligence (AI) as its cognitive brain. Most critically, evolution reflects a strategic shift away from early, fragmented technology silos toward integrated, holistic systems that foster collaboration and prioritize tangible, citizen-centric outcomes

[9] The Origins of the Smart City | by Will Brown | Medium

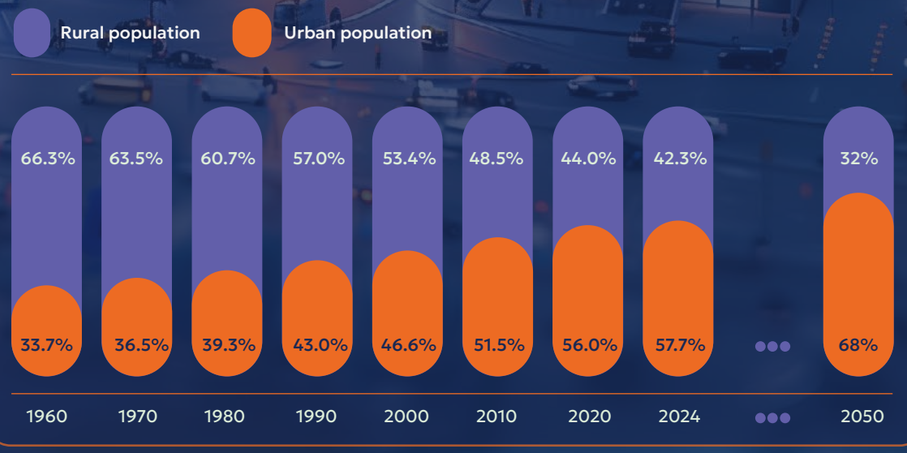
Urbanization as a Catalyst: How Global Growth Forced Cities to Innovate

2.1

Figure 2

Share of urban and rural population from 1960 to 2050

Source: United Nations, Department of Economic and Social Affairs, Population Division (2018); HYDE (2023)



The evolution of smart cities is inseparable from the broader trajectory of global urbanization. Over the past six decades, rapid industrialization, internal migration, and economic transformation have driven an unprecedented demographic shift from rural to urban living. In 1960, only 33,8% of the world's population resided in cities.[10] By 2000, this share had risen to nearly 46,7%[10], marking the rise of megacities – urban centers with populations exceeding 10 million.[11] Today, more than half of humanity lives in urban areas, and by 2050, this figure is projected to reach approximately 68,4%, with Asia and Africa leading the growth.[10]

As cities expanded, they became both economic powerhouses and pressure points. Rapid population growth strained infrastructure, housing, transportation, energy, and public services – exposing inefficiencies in traditional urban management models. In response, governments and planners began to turn toward technology, data, and innovation as strategic tools for managing complexity.

The intersection of three forces – **dense urban populations, digital connectivity, and real-time data** – created the conditions for the smart city era. Smart cities emerged not simply as a technological trend but as a systemic solution to sustain growth, optimize resources, and improve quality of life. By transforming urban challenges into opportunities for innovation, cities are redefining how they function – becoming more efficient, sustainable, and citizen-centric.

[10] WUP: The 2018 Revision

[11] Britannica: MegaCity

From Digital Cities to Citizen-Centric Ecosystems: A Historical Timeline

2.2

The intellectual roots of the smart city can be traced back to the dawn of the computer age. As early as 1974, the Los Angeles Community Analysis Bureau experimented with applying mainframe computing to urban policy challenges. Their project, Cluster Analysis of Los Angeles, sought to use computational modeling to understand poverty and urban blight. While rudimentary by today's standards, this was a pioneering attempt to treat the city as a complex data system, foreshadowing the data-driven urbanism that would emerge decades later.

1990

The 1990s introduced the concept of the "Digital City", catalyzed by the rapid spread of the internet. A seminal milestone came in 1994, when Amsterdam launched De Digitale Stad ("The Digital City") – a virtual community that offered residents internet access and new ways to communicate with local government.[12] Although primitive, this initiative is widely recognized as the starting point of the smart city movement, marking the shift from isolated computational experiments to networked, citizen-facing digital platforms. Connectivity and digital public services became the central themes of this early era.

2000

By the late 2000s, global technology firms began positioning cities as markets for digital solutions. IBM's Smarter Planet (2008) and Cisco's Connected Urban Development (2010)[13] campaigns popularized the term "smart city," emphasizing top-down, efficiency-focused solutions such as intelligent traffic management, smart grids, and sensor-based utilities.[14] While these initiatives demonstrated measurable operational benefits, including reduced energy consumption and optimized transport flows, they often prioritized technology deployment over citizen engagement, reinforcing a hardware-heavy, corporate-led model of urban intelligence.

2010

By the mid-2010s, a new paradigm emerged: citizen-centric smart cities.[15] Cities such as Barcelona, Singapore, and Songdo began integrating open-data platforms, participatory apps, and service co-design approaches that placed residents at the center of urban innovation. This era emphasized not only efficiency but also inclusivity, sustainability, and co-created public services. The evolution reflects a broader understanding: cities are complex ecosystems where technology must serve human, social, and environmental needs, not only municipal efficiency.

[12] Waag|Digital City: De Digitale Stad
[13] Cisco (Connected Urban Development) by Wolfgang Wagener
[14] Smart City: Smart Story?
[15] The Rise of the Smartivist: From Creative Class to Citizen-Centric Smart Sustainable Cities

The Three Generations of Smart Cities: 1.0, 2.0, and 3.0

2.3

A key lesson from the first generation of smart cities is that an approach of “technology for technology’s sake” is insufficient for creating sustainable and livable urban environments

Figure 3

Evolution of smart city models

The evolution of smart city thinking can be effectively understood through a three-generation model that charts the shifting balance of power and priorities among technology providers, city governments, and citizens.

Technology-Driven

Technology-push by vendors; focus on infrastructure and efficiency

Smart City 1.0

City-Led, Technology-Enabled

Municipal leadership; integration of data and services

Smart City 2.0

Citizen Co-Created

Bottom-up approach; collaboration and community engagement

Smart City 3.0

Smart City 1.0 - Technology-Driven

Smart City 1.0

The first generation was defined by a technology-push model, in which large technological companies actively promoted their solutions to city governments. This era was characterized by technological silos: isolated systems unable to communicate due to a lack of standardization and shared interfaces. Fragmentation mirrored city administrations, where data was compartmentalized across departments.

As a result, cities could deploy thousands of sensors yet still face persistent urban challenges such as traffic congestion and energy inefficiency, highlighting the limits of technology-led development without integrated governance or user engagement. This generation prioritized vendor-driven solutions and operational efficiency over citizen engagement or integrated urban planning.

Smart City 2.0 - City-Led, Technology-Enabled

Smart City 2.0

The second generation of smart cities marked a decisive shift from vendor-driven experimentation to government-led strategy and integration. Municipal leaders began to define priorities around operational efficiency, sustainability, and citizen service delivery – using technology as a coordinated tool rather than a goal in itself.

A prominent example is Rio de Janeiro's Operations Center (Centro de Operações Rio), launched in 2010 in partnership with IBM but fully managed by the city administration. The platform integrates data from more than 30 agencies[16] and monitors around 5000 cameras[17], enabling cross-departmental coordination for transport, weather, and emergency response. The initiative demonstrated how city-level leadership could turn a vendor solution into a core governance tool – reducing incident response time by roughly 30 percent and improving flood management capacity.

The defining benchmark of this generation, however, is Singapore's Smart Nation initiative, launched in 2014[18]. It represents a whole-of-government approach to embedding digital infrastructure, data analytics, and automation across all sectors of urban management. Its Smart Nation Sensor Platform (SNSP), operated by GovTech Singapore[19], enables real-time data sharing across ministries using IoT devices that monitor mobility, flood levels, and environmental quality. Meanwhile, the LifeSG app consolidates over 100 public services into a single portal, illustrating Singapore's commitment to user-centric digital government.

Smart City 2.0 embodies the "city-as-a-platform" paradigm: governments lead integration, vendors support implementation, and technology enables systemic efficiency. Yet participation remains largely top-down – citizens act as service users rather than co-designers of innovation.

[16] Rio Operations Center
[17] Rio's AI Super-Cameras
[18] Smart Nation Singapore
[19] Smart Nation Sensor Platform

Smart City 3.0 -
Citizen Co-Created

Smart City 3.0

The third generation represents a bottom-up, collaborative paradigm, where governments, citizens, academia, and startups co-design urban solutions. Technology has become a platform for participation, transparency, and social innovation.

Barcelona is a global pioneer of this model. Through its Decidim participatory platform, more than 150 000 citizens have contributed to local-policy proposals since its launch.[20] Projects such as the Superblocks Program – which reclaims streets for pedestrians and green spaces – were shaped through community consultations and have achieved a 25 percent reduction in NO_2 emissions in pilot areas[21]. Other cities, including Amsterdam, Seoul, and Medellín, have also adopted citizen-centric approaches, leveraging open data, participatory platforms, and co-creation labs to foster community-driven urban development.

In essence, Smart City 3.0 shifts the focus from deploying technology to co-creating outcomes. Success is defined not by the sophistication of infrastructure, but by the depth of citizen trust, engagement, and institutional resilience.

[20] Leading Practices in Participatory Budgeting
[21] Barcelona's superblocks improve quality of life and environmental health – IDIAP Jordi Gol.

The journey from Smart City 1.0 to 3.0 reflects a profound evolution – from managing cities through data to co-creating cities through dialogue. The maturity of a smart city is no longer measured by how advanced its technology is, but by how effectively it integrates innovation with inclusivity and accountability.

Astana International Financial Centre

Towards Integrated, Adaptive, and Resilient Urban Ecosystems

2.4

1 Cross-sector alignment

Ensures that initiatives in one domain, such as transport or housing, reinforce rather than undermine environmental and social goals.

2 Real-time resilience

Enables coordinated responses to shocks such as floods, blackouts, or health emergencies through shared data and automation.

3 Operational efficiency

Promotes predictive maintenance, dynamic infrastructure management, and resource optimization across departments.

4 Systemic robustness

Builds institutional and technical capacity to anticipate, absorb, and recover from disruptions, preventing cascading failures across interdependent networks.

The global smart-city agenda is entering a new phase - one defined by integration rather than fragmentation. Leading cities are moving beyond stand-alone digital projects toward connected, adaptive ecosystems where mobility, energy, health, and governance operate through shared data and interoperable platforms. Enabled by Internet of Things (IoT) networks, digital twins, and real-time analytics, these systems transform cities from reactive operators into proactive, intelligence-driven entities capable of continuous optimization and rapid response.

Therefore, integration is now a strategic differentiator. It enables cities to shift from incremental improvements to system-level performance gains across four dimensions: cross-sector alignment, real-time resilience, operational efficiency, systemic robustness.

Delivering this integration requires a solid digital foundation. Four enabling layers (Fig. 4) now define the architecture of modern cities—sensing, transmitting, processing, and responding to urban dynamics within a continuous feedback loop. Together, these layers function as the operating system of the future city, where technology, data, and governance converge to deliver resilience, sustainability, and long-term value creation.

Figure 4

Smart City architecture

Source: AIFC analysis

IOT Nodes, Data Collection »

Network Connectivity, Data Transfer »

Cloud Computing AI/ Analytics, Digital Twins »

User Interfaced Services, Citizen Engagement »

Sensing Layer
Nervous System

A vast network of IoT sensors, cameras, and meters continuously captures signals from the environment, monitoring everything from traffic and air quality to energy use and public safety.

Communication Layer
Circulatory System

High-capacity networks such as 5G, fiber optics, and low-power IoT protocols act as the city's digital bloodstream, transmitting information securely and efficiently across departments and infrastructure systems.

Data Management Layer
Cognitive Core

Cloud computing, AI, and digital twins function as the city's analytical brain, converting raw data into foresight – predicting energy demand, optimizing transport routes, and detecting anomalies before they escalate.

Service & Application Layer
Human Interface

Insights are delivered through dashboards, mobile apps, and citizen portals, enabling real-time decision-making, integrated service delivery, and participatory governance.

Together, these interconnected layers create a closed-loop urban intelligence framework – where IoT senses, networks connect, AI thinks, and governance acts – transforming cities from reactive managers into adaptive, learning organisms capable of anticipating and shaping their future.

Global examples demonstrate how this model operates in practice:

Across the world, leading cities are demonstrating how integrated digital ecosystems can translate data into foresight and governance efficiency. The following examples show how the four-layer architecture – from sensing to service delivery – enables urban systems to operate as adaptive, learning entities.

Singapore – Virtual Singapore:

From Static Planning to Predictive Governance

Singapore's Virtual Singapore[22] stands as one of the world's most advanced digital twin initiatives. Developed under the Smart Nation program, this USD 73 million platform integrates data from more than 100 government agencies – spanning land use, utilities, mobility, environment, and demographics – into a unified, three-dimensional model of the entire city-state. This integration allows decision-makers to simulate complex urban scenarios: assessing how new construction will affect wind patterns, flood risks, or energy loads before projects are approved. The system combines IoT data, satellite imagery, and sensor networks in real time, creating a continuously updated representation of city dynamics. For example, energy demand forecasts generated by AI models are fed directly into grid management systems, enabling adaptive energy distribution and demand-side optimization. By linking planning, operations, and citizen services through a shared digital twin, Singapore has shifted from reactive city management to anticipatory urban governance based on data foresight.

22 Singapore – "Virtual Singapore: A Digital Gateway to Urban Innovation" – article by Experion Global

Helsinki – Ethical Data Ecosystem

Citizen-Driven Transparency

Helsinki represents a European model of human-centric digital governance, focusing not just on technological deployment but on ethical and inclusive use of data. Through the Helsinki Digital Twin[23], the city integrates real-time data on mobility, energy consumption, and building performance to optimize resource allocation and carbon reduction. For instance, heat maps generated from IoT sensors feed into the Helsinki Energy and Climate Atlas[24], supporting predictive maintenance and emission forecasting across districts. What sets Helsinki apart is its transparency-by-design approach: every data flow – whether from sensors, utilities, or public services – is accessible through the city's open-data platform, enabling citizens, startups, and researchers to build applications on top of municipal datasets. Privacy and algorithmic accountability are ensured through the AI Register a public database detailing how the city uses artificial intelligence in decision-making. By combining technological precision with institutional trust, Helsinki demonstrates that digital transformation and democratic participation can reinforce each other, setting a global precedent for responsible, transparent smart city governance.

[23] "5 ways the Helsinki Smart Region is building citizen-centric and sustainable cities" – overview of data inclusion, open-data and regional innovation in Helsinki-Uusimaa

[24] Helsenki Energy and Climate Atlas

Taken together, the next generation of cities will not be judged by the scale of technology they deploy, but by how effectively digital transformation aligns with social inclusion, environmental sustainability, and institutional trust. Integration, adaptability, and resilience have become the defining hallmarks of a truly smart city.

The Global Landscape: **Lessons from pioneers and pitfalls**

3.0

The global smart-city landscape has entered a new phase of maturity. What began as fragmented pilots and technology demonstrations has evolved into integrated governance and investment systems that anchor national competitiveness. Market projections indicate that the sector is entering a decade of accelerated growth, with sustained double-digit expansion driven by urbanization, climate adaptation, and demographic pressure. At the core of this transformation lies the digital backbone - the convergence of the Internet of Things (IoT), Artificial Intelligence (AI), and digital infrastructure.

Global leaders such as Zurich, Singapore, Seoul, Copenhagen, Dubai, and Amsterdam demonstrate that successful transformation depends not on the quantity of deployed technologies, but on institutional maturity, interoperability, and citizen trust. Their progress signals a broader paradigm shift: the world's most advanced cities now treat technology as a strategic enabler of governance, embedding innovation into sustainability, inclusion, and long-term competitiveness.

Key findings

Smart Cities as a Strategic Engines of Growth

Smart cities have evolved from a technological trend into a core driver of economic competitiveness, shaped by urbanization, climate goals, and demographic change

Digital Backbone Determines Scalability

Scalable cities invest in the three pillars of the digital backbone - IoT for sensing, AI for cognition, and digital infrastructure for connectivity - creating the capacity for real-time decision-making and system-level optimization

Governance, Not Gadgets, Defines Success

Leading cities operate under unified digital authorities, measurable KPIs, and multi-year funding frameworks, ensuring that innovation delivers institutional and social outcomes rather than isolated technical wins

The Digital **Backbone of Urban** Transformation

3.1

The global smart-city market is shifting from an aspirational concept to a trillion-dollar economic reality. What was once a vision of connected urban living has become a strategic necessity, driven by structural megatrends such as rapid urbanization, demographic pressure, climate adaptation, and digital transformation. Collectively, these forces are creating unprecedented demand for intelligent, data-enabled urban infrastructure.

This evolution presents a durable growth opportunity for investors, technology providers, and policymakers alike. Across major forecasts, there is broad consensus that the smart-city market is entering a decade of accelerated expansion. According to the OECD Program on Smart Cities and Inclusive Growth, the global smart-city market is expected to grow from USD 511.6 billion in 2022 to more than **USD 1 trillion by 2027,** representing a compound annual growth rate (CAGR) of almost 15%[25].

Beneath this aggregate growth lies the digital backbone of transformation — an interconnected ecosystem powered by the Internet of Things (IoT), Artificial Intelligence (AI), and digital infrastructure. These three domains function as mutually reinforcing enablers: IoT provides a sensory network that captures real-time data from the urban environment; AI acts as the cognitive engine that interprets, predicts, and optimizes; and digital infrastructure — encompassing cloud computing, broadband, and 5G connectivity — forms the circulatory system that allows data to move securely and efficiently across systems.

[25] The OECD Programme on Smart Cities and Inclusive Growth

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Internet of Things (IoT) in Smart Cities: **From Connectivity to Intelligence**

The Internet of Things (IoT) forms the sensory layer of the smart city, providing real-time visibility across transport, energy, environmental, and safety systems. Through a vast network of interconnected sensors, meters, and devices, cities can monitor urban dynamics continuously — capturing data that feeds directly into decision-making and service optimization.

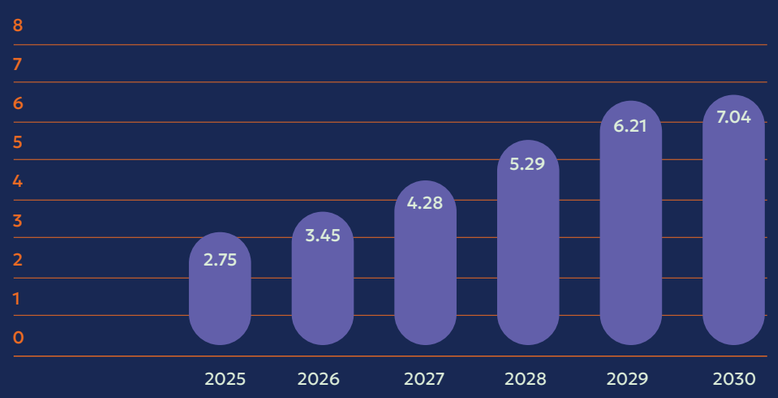
The scale of connectivity is expanding at an unprecedented pace. The number of IoT connections within smart cities is projected to exceed 7 billion by 2030 (Fig 5.). This growth reflects the accelerating deployment of intelligent infrastructure across domains such as smart energy, digital transport systems, public safety, and building automation.

Figure 5

Forecast of IoT Connections in Smart Cities

Source: Statista (2025), Internet of Things - Smart Cities

in billion U.S. devices



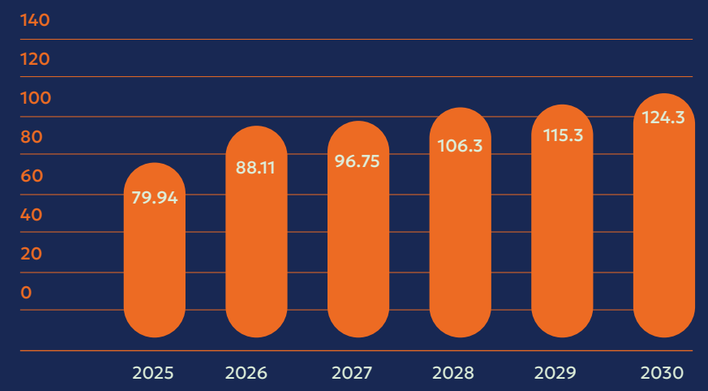
The IoT in Smart Cities submarket continues to expand rapidly, reflecting its role as the foundational layer of urban digital transformation. According to Statista (2025), the market is projected to grow to nearly USD 124,3 billion by 2030, underscoring IoT's pivotal role as the backbone of intelligent urban infrastructure (Fig. 6)

Figure 6

IoT in Smart Cities Market Size and Forecast 2025-2030

Source: Statista (2025), Internet of Things - Smart Cities

in billlion US dollars



For cities, this surge in connectivity is already translating into measurable outcomes: predictive maintenance reduces downtime, smart grids balance energy demand, and data-driven mobility platforms enhance safety and traffic flow. By transforming raw sensor data into actionable intelligence, IoT enables a shift from reactive management to proactive, real-time governance.

Artificial Intelligence (AI): **The Cognitive Core of** Urban Systems

Smart cities are rapidly adopting Artificial Intelligence (AI) to address complex urban challenges. By the end of 2025, more than **30% of global smart-city applications** are expected to be AI-powered, transforming how cities manage mobility, housing, urban planning, land use, basic services, and resilience systems[26].

Unlike earlier digital technologies that focused mainly on collecting and displaying data, AI enables cities to **interpret, predict, and act** in real time. Generative AI is reshaping urban planning by simulating development scenarios, optimizing land use, and minimizing the environmental footprint of new infrastructure. Across sectors, AI allows municipal systems to process massive volumes of real-time information, automate decision-making, and anticipate problems before they emerge — from traffic congestion and equipment failures to energy demand surges and waste-collection inefficiencies.

According to the **OECD**, global investment in AI for smart-city applications is projected to grow from USD 37.4 billion in 2023 to approximately **USD 164 billion by 2030,** reflecting a compound annual growth rate (CAGR) of **19.5%**[27]. This surge underscores the growing demand for sustainable, efficient, and data-driven urban solutions as cities worldwide deploy AI to enhance livability, reduce emissions, and strengthen resilience.

[26] 5th OECD Roundtable on Smart Cities and Inclusive Growth
[27] Proceedings of the 4th OECD Roundtable on Smart Cities and Inclusive Growth, 17 September 2024

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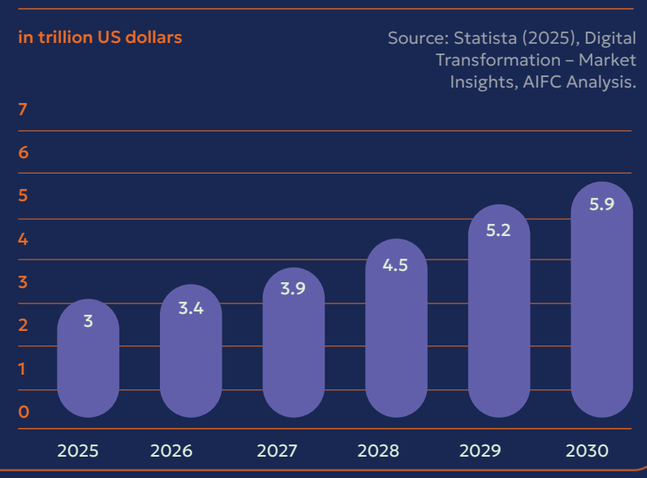
Digital Infrastructure: The Foundation for Scale

Digital infrastructure is not merely an enabler - it is the precondition for every smart-city function. Without high-capacity networks, secure cloud storage, and interoperable data platforms, cities cannot deploy or scale intelligent technologies such as IoT sensors, AI analytics, or e-government services. It forms the connective tissue that links citizens, devices, and institutions into a single, data-driven urban ecosystem. Reliable broadband, data centers, and edge computing enable cities to process vast amounts of information in real time, making governance more responsive, service delivery more efficient, and urban planning more evidence based.

Global spending on digital-transformation technologies and services is expected to rise from USD 3 trillion in 2025[28] to approximately USD 6 trillion by 2030, based on historical CAGR projections of 15 percent. Within this broader trend, urban digital investment—covering municipal cloud platforms, open-data ecosystems, and smart-service infrastructure—represents an increasingly significant share of total digital expenditure.

Figure 7

Forecast on global spending on digital-transformation technologies and Services, 2025-2030



Source: Statista (2025), Digital Transformation – Market Insights, AIFC Analysis.

The infrastructure underpinning this expansion is attracting historic levels of capital. McKinsey estimates that by 2030, companies will invest approximately USD 7 trillion in data-center infrastructure globally, with over 40 percent of that directed to computing and hardware[29]. This unprecedented scale underscores the centrality of data infrastructure as a strategic asset class in the global economy.

At the intersection of urbanization and digitalization, the smart-city model leverages these capabilities to enable efficient resource use, deliver high-quality public services, and drive sustainable economic growth.

Cities that invest early in scalable connectivity, secure data platforms, and open digital architectures will be best positioned to capture the productivity and resilience dividends of this transformation.

[28] Worldwide Spending on Digital Transformation is Forecast to Reach Almost $4 Trillion by 2027, According to New IDC Spending Guide

[29] McKinsey & Company (2024) The cost of compute: A $7 trillion race to scale data centers

Global Leaders: **Benchmarking Success Stories**

3.2

The deployment of smart-city technologies has matured beyond pilot initiatives – success is now defined by measurable system-level outcomes that enhance productivity and sustainability.

The global evolution of smart-city development has advanced beyond isolated pilot projects – success today is defined by integrated, system-level outcomes that enhance urban productivity, sustainability, and overall quality of life. A group of frontrunner cities - Zurich, Singapore, Amsterdam, Copenhagen, Dubai and Seoul – have progressed from experimentation to full-scale implementation, demonstrating how digital integration, cross-sector collaboration, and citizen-centric design can create measurable economic and social value.

While each operates within distinct economic, and cultural contexts, they share a common strategic approach: technology is treated as an instrument of transformation, not an end. Their experiences reveal a consistent set of enablers – a clear strategic vision, cross-sector coordination, sustained investment, and a culture of performance measurement – that collectively underpin scalable and sustainable urban transformation.

Zurich:
Sustainability by Design and Data-Driven Governance

3.2.1

Zurich demonstrates how evidence-based governance can transform sustainability from an environmental goal into a foundation of long-term urban competitiveness

Figure 8

General overview - Zurich

Country	Switzerland
Population of the city	436,551
City Area (km2)	87,9
Population density	4,967/ km2
GDP per capita	USD 83,165
Average Monthly Salary	USD 5,660
IMD Smart City ranking 2025	1st place
TOMTOM traffic index ranking	80th Place (Travel time over 10 km - 26 min 18 sec)

Zurich is widely recognized as one of the world's most advanced and balanced smart cities – where technology, sustainability, and citizen trust reinforce one another through a model of disciplined governance and long-term planning. According to the IMD Smart City Index 2025[30], Zurich ranked first out of 146 cities worldwide for the sixth consecutive year. The index credits the city's success not only to digital infrastructure and service efficiency but also to its "humane dimensions" – quality of life, inclusiveness, and environmental performance.

Central to this success is the Smart City Zürich Framework[31], launched in 2018, which coordinates innovation across energy, mobility, housing, and governance through an integrated approach. Within this framework, the Zürich-West Innovation District functions as a 100-hectare urban living laboratory, transforming a former industrial zone into a mixed-use innovation hub that combines smart infrastructure, renewable-energy systems, circular economy principles, real-time mobility management, and participatory governance. The district exemplifies Switzerland's pragmatic approach – using technology to solve tangible urban challenges while preserving cultural and architectural heritage.

At the heart of Zurich's energy transition lies the "2000-Watt Society" concept – an internationally recognized vision to cut per-capita energy use to 2,000 watts and limit annual CO_2 emissions to 1 ton per person[32]. Pilot districts such as Zürich-West are already contributing measurable progress toward these goals through energy-efficient construction and district-heating integration.

In mobility, Zurich ranks 9th globally in the Oliver Wyman Forum Urban Mobility Readiness Index 2023[33], reflecting its reliability, connectivity, and strong public-transit coverage. With a 74% green mobility share, the city promotes cycling, electric transport, and multimodal integration through intelligent traffic management and digital payment platforms. Zurich also maintains one of Europe's safest road networks, with a traffic fatality rate of just 0.07 per 10,000 residents.[34]

Zurich's achievements are reinforced by external validation. It holds EarthCheck Sustainable Destination certification, ranks 13th globally in the GDS-Index (2024)[35] for sustainable urban management, and placed 2nd in the Happy City Index 2025[36], highlighting high income, excellent health standards, and public satisfaction with mobility and governance.

[30] Zurich - IMD business school for management and leadership courses
[31] Smart City Zurich Strategy
[32] Booklet of positive energy districts in Europe
[33] How Zurich Performs Across Urban Mobility Targets
[34] Zurich City Profile at Happy City Index
[35] The 2024 GDS-Index Reveals its Top 40 Sustainable Destinations
[36] Happy City Index 2025

Practical Insights: **Zurich experience demonstrates that smart-city maturity comes from institutional integration, disciplined governance, and citizen trust, rather than rapid technology deployment. Its Smart City Zurich Framework provides a unified structure linking energy, mobility, and digital governance under measurable KPIs, ensuring every innovation serves a defined public purpose. The Zurich-West innovation district shows how cities can pilot and refine technologies – such as AI-driven energy grids and participatory planning tools – before scaling them citywide, reducing both risk and cost. Strong data governance and privacy standards maintain public confidence, while performance-based funding and cross-sector partnerships ensure long-term sustainability.**

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Figure 9

Zurich's Smart Nation: Example Initiatives and Achievements

Sources: City of Zürich (2024); ewz Annual Report 2023; IMD Smart City Index 2025; Oliver Wyman Forum (2023); UN DESA EGDI 2024; Earth Check; Switzerland Innovation Park Zurich

Strategic Area	Flagship Initiatives / Policies	
Sustainability & Energy Transition	**2000-Watt Society –** long-term framework targeting ≤ 2,000 watts primary-energy use and ≤ 1 ton CO_2 per capita annually **Net Zero Zurich 2040 –** city-wide decarbonization roadmap linking energy, mobility, and construction.	**ewz Renewable Energy Program –** municipal utility supplying > 90 % renewable electricity (2023 revenue CHF 1.57 bn, net profit CHF 370 m, reinvested in smart-grid and storage project)
Mobility & Accessibility	**Smart Mobility Zurich –** integrated system connecting trams, buses, rail, and e-mobility through the ZVV app (real-time info + ticketing) **Zurich-West Innovation District –** pilot district using IoT and AI to manage multimodal traffic and charging networks	**Ranked 9th globally in the Oliver Wyman Urban Mobility Readiness** Index 2023
Digital Governance & Data	**Smart City Zurich Framework (2018) –** master plan for data integration, innovation management, and open governance **Open Zurich Data Platform –** > 700 datasets enabling AI and urban-analytics research across sectors	**eGovernment Zurich –** unified citizen portal aligned with Swiss Digital ID and blockchain-secured registries: Switzerland's EGDI 2024 score 0.9004 (Ranked 26th globally).
Economic & Financial Resilience	**Switzerland Innovation Park Zurich –** national hub for AI, robotics, and cleantech **Zurich Green Bond Framework –** ESG-linked municipal financing supporting energy-efficiency and transport projects	**Public-Private Partnerships via ewz –** co-investment in smart-grid and district-heating infrastructure
Trust, Inclusion & Quality of Life	**Smart Participation Portal –** online citizen-feedback and participatory-planning platform (tens of thousands of annual inputs) **Zurich Card -** An integrated pass providing access to municipal transport and cultural service	**Inclusion Standards Program –** accessibility audits across public buildings **>70 % of residents** report easy access to city information **Zurich** ranked **2nd globally** in the Happy City Index 2025

Singapore – From Data Islands to a Nation-as-a-Platform

Figure 10

General overview - Singapore

Country	Singapore
Population of the city	6,111,200
City Area (km2)	736
Population density	8,300/km2
GDP per capita	USD 94,480
Average Monthly Salary	USD 4,125
IMD Smart City ranking 2025	9th Place
TOMTOM traffic index ranking	206th Place (Travel time over 10 km – 22 min 20 sec)

3.2.2

Singapore shows that long-horizon coordination and citizen-first design are as important as advanced tech

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Singapore's Smart Nation initiative stands as one of the most mature and comprehensive digital transformation strategies worldwide. First launched in 2014 and refreshed through the **Smart Nation 2.0** strategy in 2024[37], the program has evolved from building digital capabilities toward a holistic national vision anchored on three goals – **Trust, Growth, and Community.** This next phase places citizens at the center of technology deployment, ensuring that innovation not only enhances efficiency but also strengthens resilience, inclusiveness, and social cohesion.

Over the past decade, Singapore has achieved near-universal digital access and adoption. Ninety-nine percent of resident households are connected to the internet, and almost all government services (99%) are available online[38]. The national digital identity platform SingPass provides citizens access to more than 2,700 public and private services[39], while PayNow and GovWallet facilitate secure, instant transactions across the economy. The digital economy contributed 17.7% to GDP in 2023[40], expanding at more than double the pace of the broader economy, with 95% of SMEs adopting digital technology[41].

Over 200,000 tech professionals are employed nationwide, supported by continuous upskilling programmes such as TechSkills Accelerator (TeSA)[42] and the Digital Enterprise Blueprint, which link workforce transformation to business innovation.

Digital infrastructure and connectivity form the backbone of this success. The Digital Connectivity Blueprint (2024) commits to doubling submarine cable capacity within the next decade and delivering broadband speeds of up to 10 Gbps by 2026[43], supported by a 5G network that already covers 95% of the country[44]. Complementing this, the Green Data Centre Roadmap and National AI Strategy 2.0 are advancing Singapore's next phase of sustainable digital growth – balancing energy-intensive data infrastructure with environmental goals while investing over S$1 billion in AI capabilities for public good[45].

At the community level, Smart Nation 2.0 places equal emphasis on inclusion and trust. The Digital for Life movement has reached more than 400,000 citizens[46], equipping seniors, low-income households, and persons with disabilities with essential digital skills. National frameworks such as the Cybersecurity Act (2018)[47], Online Criminal Harms Act (2023)[48], and AI Verify Framework (2024)[49] ensure that technology development remains transparent, secure, and accountable. This dual focus on empowerment and protection exemplifies how Singapore balances innovation with human-centric governance.

Mobility is another hallmark of Singapore's leadership. The city maintains a 67% green-mobility share, supported by real-time journey-planning tools, barrier-free public transport, and fully integrated payment systems. Traffic-related fatalities are among the world's lowest — 0.24 per 10,000 residents — underscoring the success of data-driven safety systems[50].

Economically, Singapore remains a global hub of innovation and entrepreneurship, with over 100 businesses per 1,000 residents,[50] an unemployment rate near 2%, and consistent top-tier performance in global competitiveness indices. Its economic model combines digital innovation, regulatory stability, and human-capital excellence — positioning Singapore as both a Smart Nation and a blueprint for governance-driven innovation in the 21st century.

[37] Smart Nation 2.0
[38] Singapore Digital Society Report 2023 by Infocomm Media Development Authority
[39] Singpass | Government Technology Agency of Singapore (GovTech Singapore)
[40] Singapore Digital Economy Report 2024, Infocomm Media Development Authority
[41] Smart Nation 2.0 (2024) A Thriving Digital Future for All
[42] Techskills Accelerator
[43] Digital Connectivity Blueprint (DCB) | IMDA
[44] Singtel's 5G network surpasses 95% nationwide coverage
[45] Smart Nation 2.0 Report
[46] Architecting Singapore's Digital Future by IMDA Report
[47] Cybersecurity Act 2018 - Singapore Statutes Online
[48] Online Criminal Harms Act 2023 - Singapore Statutes Online
[49] Model AI Governance Framework for Generative AI | IMDA
[50] Singapore | Institute For Quality of Life

Practical Insights: Singapore's experience shows that smart-nation success depends on governance discipline, interoperability, and inclusion. Its unified digital identity, clear regulatory frameworks, and outcome-based funding ensure coherence across agencies, while test-and-scale innovation – through AI sandboxes and digital-twin pilots – reduces risk before nationwide rollout. Most critically, continuous investment in digital literacy and data trust turns technology into a reliable public good, proving that sustainable digital transformation starts with people, not platforms.

Figure 11

Singapore's Smart Nation: Key Initiative, Results

Source: Smart Nation 2.0: A Thriving Digital Future for All – Government of Singapore, (SNDGO), 2024, IMDA (2024)

Strategic Area	Flagship Initiatives / Policies	
Digital Governance & Citizen Services	**SingPass / MyInfo** – unified national digital identity enabling secure access to 2,700+ services across public and private sectors **GovWallet & PayNow** – integrated digital-payment platforms supporting government disbursements and citizen transactions	**Smart Nation Sensor Platform (SNSP)** – cross-agency IoT infrastructure collecting data for public safety, environment, and mobility services Singapore ranks **3rd globally in the UN E-Government Development Index**
Infrastructure & Connectivity	**Digital Connectivity Blueprint (2024)** – national strategy to achieve 10 Gbps broadband speeds by 2026 **Green Data Centre Roadmap (2024)** – promotes energy-efficient, low-carbon data centers through green power and advanced cooling systems	**5G nationwide coverage now exceeds 99%,** enabling IoT, autonomous mobility, and high-bandwidth enterprise applications
Artificial Intelligence & Innovation	**National AI Strategy 2.0** – expansion of AI use across healthcare, logistics, and urban management, supported by **S$1 billion AI investment** **Generative AI Sandbox** – accelerates AI adoption for SMEs and public services through test-and-scale deployment	AI integration contributes to Singapore's digital economy valued at **US$84.5 billion (≈17.7% of GDP, 2024)**[51]
Sustainability & Urban Systems	**Virtual Singapore –** 3D national digital twin for urban planning, infrastructure monitoring, and climate resilience modeling **Smart Mobility and Smart Waste Systems** – optimize public transport, waste collection, and emissions management using IoT and analytics	**Singapore Green Plan 2030** – targets include at least 2 GWp solar capacity by 2030, 50% electric bus fleet by 2030 67% of residents commuting within 45 minutes via Walk–Cycle–Ride mode[52]
Digital Inclusion & Skills	**Digital for Life Movement** – promotes digital literacy across age groups; over 400,000 citizens trained since 2021 **TechSkills Accelerator (TeSA)** – national reskilling program creating a tech workforce of 200,000+ professionals	**SME Go Digital** – achieved ≈95% digital adoption among small and medium enterprises
Cybersecurity & Trust Frameworks	**Cybersecurity Act** – national framework for critical infrastructure protection and incident response **Online Criminal Harms Act** – safeguards citizens against digital scams and misinformation	**AI Verify Framework** – first government-led AI governance testing toolkit ensuring transparency, accountability, and safe deployment of AI systems

[51] Singapore – Information and Telecommunications Technology

[52] Transport | Singapore Public Sector Outcomes Review 2024

Seoul – A Citizen-Centric Model of Digital Governance

Figure 12

General overview - Seoul

Country	South Korea
Population of the city	10,025,800
City Area (km2)	605.21
Population density	17,000/km2
GDP per capita	USD 36,239
Average Monthly Salary	USD 3,267
IMD Smart City ranking 2025	13th Place

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3.2.3

Seoul illustrates that digital governance succeeds not through technology alone, but through the trust and participation of its citizens

Seoul has emerged as one of the world's leading examples of how technology, transparency, and citizen participation can reshape the relationship between government and society. Its smart-city strategy reflects South Korea's broader Digital New Deal vision, which combines data-driven governance with active civic engagement.

At the core of this transformation is the Seoul Smart City Platform, which connects more than 120 public services – from transport and environment to safety and utilities – through a single, real-time data hub. The Digital Mayor's Office consolidates information from over 300 municipal systems, allowing officials to visualize and manage citywide operations instantly[53]. Complementing this, the Seoul Open Data Plaza provides access to more than 6,000 datasets, enabling universities, start-ups, and civic groups to co-develop digital solutions[54]. This approach has positioned Seoul as one of the most transparent and data-enabled governments in the OECD.

Citizen participation is deeply embedded in Seoul's governance framework. The mVoting mobile app allows residents to propose and vote on policies, with citizens initiating 88 percent of 4,400 proposals, leading to the adoption of 181 municipal policies[55]. The Oasis platform crowdsources public ideas for urban improvements, while the 120 Dasan Call Center handles over 22,000 inquiries daily, functioning as both a service hub and early warning system for emerging issues[56]. The integration of citizen feedback into policymaking has made governance more responsive and collaborative.

Spatial intelligence and predictive analytics further enhance efficiency. The Digital Twin Seoul (S-Map) system integrates 3D mapping, IoT, and satellite data to model traffic flow, flood risk, and construction safety – enabling planners to test policies virtually before implementation. The TOPIS traffic-control center[57] manages live transport data, while the "Owl Bus" late-night service[58], designed using 3 billion mobile phone data points, optimizes routes to match actual demand. These initiatives have contributed to increasing Seoul's public transport share[59] from below 30 percent to nearly 70 percent.

Infrastructure and safety are supported by the S-Net high-speed communication backbone and S-Security, a centralized CCTV network managing over 176,000 cameras[60]. The city also provides free public Wi-Fi at more than 12,000 locations, reducing communication costs and bridging digital divides. Under its Smart Seoul 2030 Roadmap, the city continues expanding this digital foundation to support energy efficiency and sustainability.

The city's financial commitment to this vision has seen substantial growth. Each year, Seoul allocates approximately 1% of its budget to smart city projects annually[61]. In 2012, it invested 100 million USD[62] (around 0.57% of the total budget of 16.6 bln USD) in Smart Seoul initiatives. By 2022, this investment had quadrupled, reaching 1.2 percent of the city's total budget[63], a scale that reflects Seoul's evolution from pilot projects to systemic digital infrastructure. This stable funding model ensures continuity across political cycles and allows the city to maintain long-term partnerships with technology providers and research institutions.

[53] Smart Cities Around the World: Seoul
[54] Smart City Korea
[55] Healthier Democracies Case Study: Seoul, South Korea, MULTICHANNEL COMMUNOCATION WITH CITIZENS, by Melisa ross, 2022
[56] Seoul Solution: 120 Dasan Call Center
[57] Seoul TOPIS
[58] Seoul Solution: Night Bus|Route Design Using Big Data
[59] Integrated Public Transport Fare System
[60] Seoul Metropolitan Government
[61] Towards a Sustainable Future
[62] Towards a Sustainable Future
[63] Towards a Sustainable Future

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Practical Insights: Seoul's model underscores that trust, transparency, and citizen agency are as vital to smart-city success as technology. The city's integration of open data, participatory platforms, and predictive analytics demonstrates how digital governance can enhance both efficiency and legitimacy. Its Digital Twin and TOPIS systems show how data-driven modeling reduces risk and cost before implementation, while sustained budgetary commitment ensures policy continuity beyond political cycles. For other countries, Seoul offers a replicable path: start with citizen feedback loops, ensure data openness and cross-agency integration, and scale innovation only when governance and inclusion mature – transforming digital transformation into democratic transformation.

Figure 13

Seoul: Core Initiatives and Measurable Outcomes

Source: Towards a Sustainable Future, K-Smart City

Strategic Area	Flagship Initiatives / Policies	
Data-Driven Governance	**Seoul Smart City Platform –** integrates 120+ public services into a unified real-time data hub	**Seoul Open Data Plaza –** provides 6,000+ datasets for public and private innovation
	Digital Mayor's Office – central dashboard linking 300+ municipal systems	
Citizen Participation & Inclusion	**120 Dasan Call Centre –** centralized citizen service and complaints line; daily inquiries historically ~22,000	**mVoting –** mobile app enabling citizen proposals and voting in municipal policy (citizen-initiated high share; specific numbers vary and some claims unverified)
Urban Analytics & Mobility	**Digital Twin Seoul (S-Map) –** 3D and IoT-enabled model used for planning traffic, floods, construction.	**"Owl Bus" Late-Night Service –** designed using mobile data (3 billion data points referenced) to optimise routes
Infrastructure & Safety	**S-Net / City broadband backbone** and public-WiFi network – extensive connectivity rolled out across Seoul	CCTV and sensor networks (e.g., large camera installations) used for public safety and monitoring
Financing & Inclusion	**Smart Seoul 2030 Roadmap –** sets citywide goals for sustainability and inclusion	**Dedicated 1% annual budget** for smart-city development, up from USD 100 m in 2012 to 1.2% of budget in 2022.

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Copenhagen – Climate-Smart Digital Transformation

Figure 14

General overview - Copenhagen

Country	Denmark
Population of the city	667,099
City Area (km2)	90.90
Population density	7,339/km^2
GDP per capita	USD 76 580
Average Monthly Salary	USD 7996
IMD Smart City ranking 2025	7th Place
TOMTOM traffic index ranking	83th Place (Travel time per 10km – 26 min 7 sec)

3.2.4

Copenhagen demonstrates that the smartest cities are those that use digital technology to achieve measurable climate progress and citizen well-being, not just operational efficiency

Copenhagen stands as a global benchmark for embedding climate strategy, urban design, and digital systems under one governance framework. It originally aimed to become the world's first carbon-neutral capital by 2025[64], but in 2022 city officials acknowledged the target would be postponed[65], largely due to funding and technical challenges with carbon capture at its waste-to-energy plant.

The city's innovation engine is driven by the **Copenhagen Solutions Lab (CSL)**, established in 2014 as the municipal innovation hub for cross-sector experimentation in climate, energy, mobility, and data governance. One of its early projects – the City Data Exchange (developed with Hitachi) – pioneered a shared data marketplace. Though later succeeded by newer platforms, it laid the groundwork for Copenhagen's open-data governance model, which today includes more than 200 public datasets accessible to citizens and businesses[66].

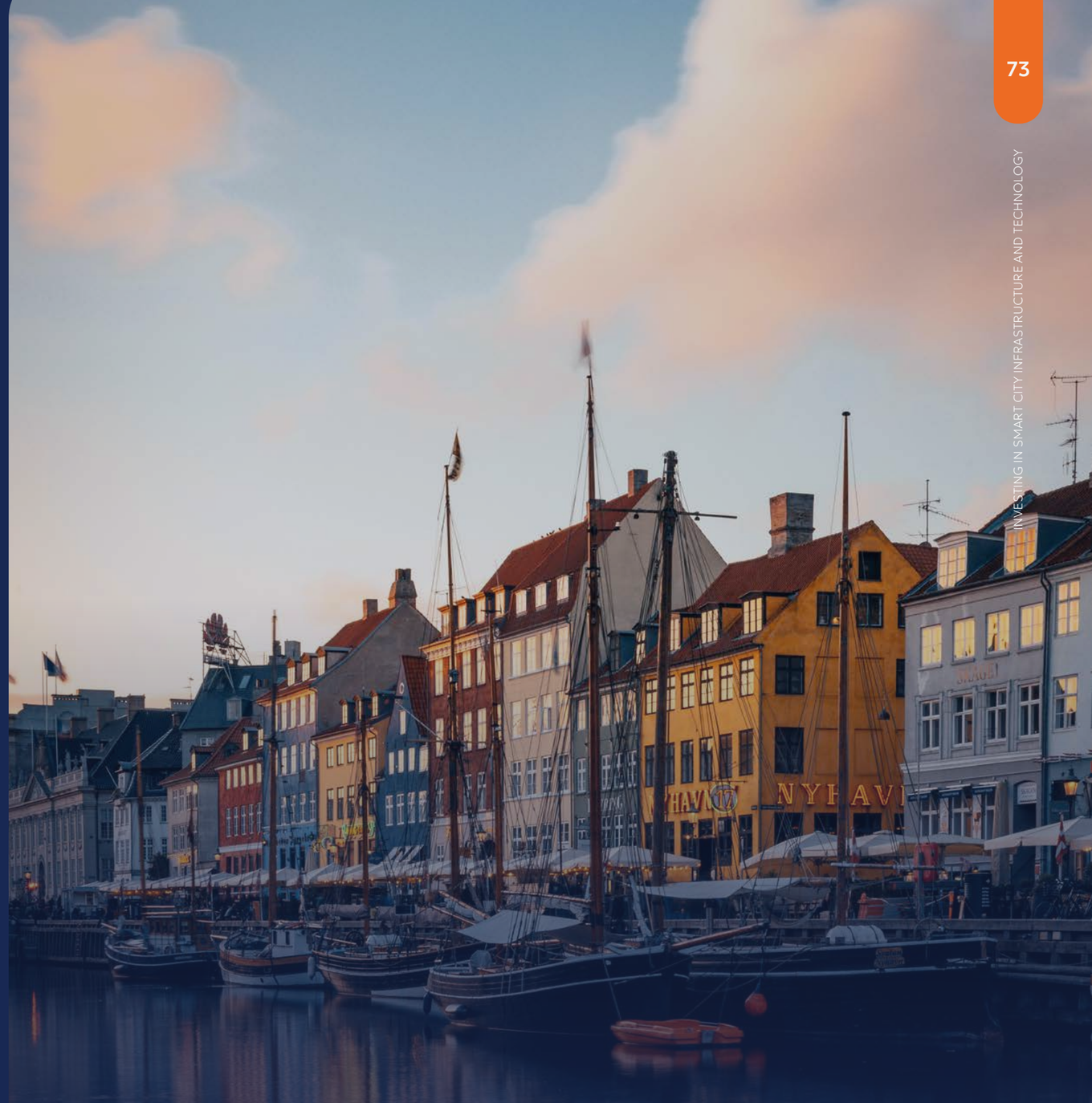
Digitalization supports Copenhagen's climate agenda across multiple sectors. In mobility, adaptive traffic lights, cycling-data analytics, and sensor-driven public-transport systems optimize urban flow and safety. In energy, the city employs predictive analytics and IoT to manage district-heating and building-energy systems, cutting heat losses by roughly 20% and enabling efficient use of renewables. Flagship projects such as **Energy Lab Nordhavn** provide living testbeds for carbon-neutral neighborhoods, demonstrating how digitally enabled smart grids balance local supply and demand in real time. Waste and resource management benefit from digital monitoring: the **CopenHill** waste-to-energy facility converts non-recyclable waste into electricity for ≈ 30 000 households and heating for ≈ 72 000,[67] while sensor-based bins and route-optimization systems have reduced emissions and operating costs.

Citizen engagement and transparency are embedded in governance through initiatives like **Co-Create Copenhagen**, which facilitates participatory planning, and through the city's digital public-service portals that enable fault reporting, electronic payments, and online consultations. Civic participation remains strong, with around 60 percent voter turnout in local elections and widespread digital literacy — 98 percent of residents possess core digital skills and 86 percent speak at least one foreign language.[69]

Copenhagen's broader socioeconomic indicators reinforce its leadership in human-centric innovation. Copenhagen continues to rank among the world's smartest and most sustainable cities – placing within **the top 10 globally in the IMD Smart City Index 2025**[68] and frequently cited by the EU Smart Cities Marketplace for its climate-aligned governance. The city also ranked **1st globally in the 2025 Happy City Index,** reflecting high levels of social trust, environmental quality, and digital inclusion.[69] Education and innovation form the backbone of this success: 11 percent of residents engage in lifelong learning, 20 percent hold a master's degree, and the city records 6.3 patents per 10 000 inhabitants — among the highest in Europe[69].

While Copenhagen's carbon-neutrality timeline has been adjusted, its integrated approach — linking digitalization, innovation, and sustainability under a single strategic framework — continues to position the city as one of the world's most advanced and resilient urban models.

[64] How Copenhagen plans to become the world's first carbon neutral capital – CityTalk
[65] Climate: Copenhagen postpones bid to become first CO2-neutral capital
[66] Copenhagen City Profile at Happy City Index
[67] Copenhill Press Kit 2019
[68] Copenhagen - IMD business school for management and leadership courses
[69] Happy City Index 2025



Practical Insights: Copenhagen's experience highlights that digitalization becomes transformative when bound to measurable climate goals and citizen co-creation. Its use of real-time data to manage district heating, waste, and mobility shows how smart technologies can drive tangible CO_2 reductions. The city's innovation-lab model (CSL) provides a scalable template for coordinating cross-sector pilots, while stable climate funding and open-data partnerships ensure transparency and long-term continuity. For emerging economies, Copenhagen offers a practical lesson: integrate digital systems with climate metrics, civic engagement, and institutional stability to convert sustainability targets into accountable, data-driven outcomes.

Figure 15

Copenhagen – Climate-Smart Digital Transformation: Key initiatives

Source: Digital Hub Denmark – Official National Digitalization Platform, EnergyLab Nordhavn Project

Strategic Area	Flagship Initiatives / Policies	
Climate & Energy Strategy	**EnergyLab Nordhavn –** A smart-energy lighthouse project integrating renewables, district heating, and electric mobility in Nordhavn	
Digital Governance & Innovation	**Copenhagen Solutions Lab (CSL) –** The city's official unit for public-private innovation. It functions as a testbed for new solutions.	**Digital Hub Denmark –** National GovTech catalyst linking international stakeholders with Danish digital public-sector innovation
Smart Mobility	**Intelligent Traffic Management System –** Real-time adaptive signaling, congestion monitoring, and multimodal data integration	**Cycling Data Program & Super-Cycle Highways –** IoT sensors and analytics applied to Copenhagen's advanced cycling infrastructure
Energy & Buildings	**District Heating Digital Twin** – Predictive control system optimizing heat distribution and reducing losses across neighborhoods	**Building Energy Management Systems (BEMS) & Smart Lighting Pilot –** Upgrades including ~19,000 networked LED streetlights with sensor controls and dimming
Waste & Resource Management	**CopenHill Waste-to-Energy Plant –** Transforms waste into electricity and heat, integrated with recreational functions and data monitoring	**Sensor-Based Waste Collection & Street Lab –** Smart sensors in bins and urban spaces to optimize collection routes and monitor environmental conditions
Citizen Engagement	**Co-Create Copenhagen –** participatory design platform **Digital Consultations** on planning and sustainability	**City Free WiFi -** Internet access for tourists and online information for citizens and tourists regarding activities and opportunities in the city

Astana International Financial Centre

Dubai – Data-Driven Governance at Scale

Figure 16

General overview - Dubai

Country	UAE
Population of the city	3 944 751
City Area (km2)	544
Population density	7250/km2
GDP per capita	USD 49,498
Average Monthly Salary	USD 5,853
IMD Smart City ranking 2025	4th Place
TOMTOM traffic index ranking	274th place (Travel time per 10km – 18 min 3 sec)

3.2.5

Dubai – Data-Driven Governance at Scale
When governance, data sharing, and AI sit under one authority, cities move from pilots to system impact

Astana International Financial Centre

Practical Insights: Dubai's trajectory demonstrates how centralized data governance, citizen-centric design, and performance-driven policy can transform urban management at scale. By integrating real-time sentiment monitoring, AI-enabled infrastructure, and measurable climate innovation within a single regulatory framework, Dubai has turned digital transformation into a governance model rather than a technology project. For other countries, the key takeaway is clear: smart-city success dependson cross-sector data integration, outcome-based metrics, and sustained institutional coordination that align technology with both economic competitiveness and citizen satisfaction.

Dubai represents one of the world's most ambitious examples of government-led digital transformation. The emirate's vision – to become the **world's smartest and happiest city** – has evolved from a technology-led initiative into a fully integrated model of data governance, digital economy, and AI-powered public services. Guided by the Smart Dubai Strategy and now advanced under the Digital Dubai Authority, the city has digitized nearly all public services while catalyzing innovation through public–private collaboration and advanced data infrastructure.

At the center of this transformation is the **Dubai Pulse Platform**, a citywide data exchange developed in partnership with du Telecom, which consolidates thousands of datasets across health, logistics, energy, and education, providing real-time insights and open data for businesses and researchers. Complementing it, the **DubaiNow app** integrates over 280 government and private services into a single interface, while the Happiness Meter Dashboard, one of the world's first real-time sentiment measurement system, tracks satisfaction across 1,000+ service centers and 2,900+ counters, recording over 58 million votes and achieving a 96% happiness index in 2023[70].

Under the UAE National AI Strategy 2031, Dubai has become a **regional hub for artificial intelligence**. The Dubai AI Lab, established with IBM, develops domain-specific AI applications across healthcare, mobility, and public services, while the **Dubai Blockchain Strategy 2030** aims to migrate all eligible government transactions to blockchain platforms, enhancing transparency and security.

Digitalization extends into urban systems and mobility. The Roads and Transport Authority (RTA) operate the UTC-UX Fusion System, combining AI and predictive analytics to optimize signal control, improving traffic efficiency across key intersections by up to 37 %[71]. The Smart Police Stations (SPS), operating 24/7 in multiple languages, provide contactless policing services, while the Autonomous Transportation Strategy 2030 targets 25 % of all city trips to be driverless[72].

In the utilities sector, Dubai Electricity and Water Authority (DEWA) leads globally in smart infrastructure. Its Smart Grid Strategy 2021–2035 uses IoT and AI for predictive maintenance and energy optimization, achieving 2 % electricity line losses, 4.6 % water losses, and a record 1.06 minutes of Customer Minutes Lost per year (2023)[73] – among the best performance metrics worldwide.

The city's digital transformation has also reshaped its economy. According to the UAE Digital Economy Strategy, the **digital sector contributes approximately 11.7% of the national non-oil GDP,** with Dubai accounting for the majority share. Dubai Internet City (DIC) anchors this ecosystem, hosting 4,000 + companies and 31,000 professionals, and generating an estimated AED 100 billion in economic impact over the past 15 years[75]. Its in5 incubator network has helped start-ups raise ≈ AED 8 billion in venture funding[76].

Beyond digital governance, Dubai aligns technology with climate and sustainability objectives. The Mohammed bin Rashid Al Maktoum Solar Park – the world's largest single-site solar project – targets 5 GW capacity by 2030, supporting the UAE's clean-energy ambition of 75 % renewables by 2050. The Sustainable City showcases eco-smart urban living powered by solar energy and smart meters, while the Dubai 3D Printing Strategy aims for 25 % of new buildings to be 3D-printed by 2030.

[70] Happiness Meter – Digital Dubai

[71] Dubai's traffic signal upgrade: New AI system cuts delays by up to 37%

[72] Dubai reveals autonomous transport ambitions for 2030 | The First Group

[73] DEWA's Smart Grid | Contributing to making Dubai the smartest city in the world

[74] UAE digital economy strategy fuels tech transformation – TR – Legal Insight MENA

[75] DIC champions global partnerships to bolster future digital economy at GITEX Global

[76] in5 start-up funding grows to AED 8 billion | TECOM Group

Figure 17

Dubai - Data-Driven Governance at Scale: Key initiatives and Achievements

Source: Digital Dubai Authority (2024), DEWA Sustainability Report (2023); UAE Smart Cities Report (2024)

Strategic Area	Flagship Initiatives / Policies	
Digital Governance & Citizen Experience	**Dubai Pulse Platform –** citywide data exchange integrating government and private datasets. **DubaiNow App –** unified access to 280 + digital services; 100 % paperless government achieved.	**Happiness Meter Dashboard –** world's first live sentiment-tracking system across 1,000 + service centers and 2,900 + counters
AI & Emerging Technology	**Dubai AI Lab (with IBM) –** sector-specific AI for health, logistics, and city management. **Dubai Blockchain Strategy 2030 –** migration of all eligible government transactions to blockchain.	**Autonomous Transportation Strategy 2030 –** targets 25 % of trips to be autonomous.
Mobility & Safety	**RTA UTC-UX Fusion System –** AI and predictive analytics reduce congestion by up to 37 % on pilot routes. **Smart Police Stations (SPS) –** 22 + fully automated 24/7 stations offering multilingual digital services.	**Volocopter Air Taxi Program –** world's first autonomous passenger air-mobility trials.
Energy & Buildings	**DEWA Smart Grid Strategy 2021–2035 –** IoT-enabled predictive control; 2 % electricity losses, 4.6 % water losses, 1.06 min CML (2023). **Mohammed bin Rashid Solar Park –** world's largest single-site solar project, 5 GW by 2030.	**Dubai 3D Printing Strategy 2030 –** 25 % of new buildings to be 3D-printed.
Digital Economy & Innovation	**Dubai Internet City (DIC) –** 4,000 + companies, 31,000 professionals; AED 100 billion GDP impact. **in5 Incubator Network –** start-ups raised ≈ AED 8 billion.	**Digital Nomad Visa (2021) –** attracts global remote-tech talent.

Abu Dhabi – AI-Native Governance and Sustainable Urban Innovation

Figure 18

General Overview - Abu Dhabi

Country	UAE
Population of the city	2 189 260
City Area (km2)	972
Population density	2,250 /km2
GDP per capita	USD 84,900
Average Monthly Salary	~USD 4,084
IMD Smart City ranking 2025	5th Place
TOMTOM traffic index ranking	194th Place/ (Travel time per 10km – 20 min 41 sec)

3.2.6

When AI, data governance, and sustainability are integrated under one coordinated authority, cities advance from digital pilots to measurable system-wide impact

Astana International Financial Centre

THE NEXT WAVE OF URBAN DEVELOPMENT

Practical Insights: Abu Dhabi showcases how coordinated digital governance, AI integration, and large-scale clean-energy ecosystems can create a scalable smart-city model. The emirate's combination of AI-native public administration, sustainability leadership, and citizen-centric design provides a blueprint for countries seeking to achieve impactful, system-wide digital transformation.

Abu Dhabi has emerged as one of the world's leading smart-city models, combining AI-native governance, advanced digital services, and sustainability-focused urban systems. Guided by the Abu Dhabi Digital Strategy 2025–2027 and the Smart City Strategy 2030, the emirate has built an integrated framework spanning data governance, AI deployment, clean energy, mobility, and citizen-centric public services.

The Department of Government Enablement (DGE) oversees digital transformation across government entities, with unified data standards enabling real-time analytics and proactive service delivery. Through TAMM, Abu Dhabi digitized 1,100+ services and processed 52 million transactions in 2024, significantly reducing paperwork and speeding up government service delivery[77].

Abu Dhabi was among the first regional cities to apply AI and IoT to public-service delivery. AI-enabled inspection robots and environmental sensors monitor parks and public facilities, while predictive analytics optimize energy and water consumption. These systems improve efficiency, reduce operational costs, and align with the emirate's long-term sustainability goals.

A central pillar of Abu Dhabi's smart-city transformation is Masdar City, one of the world's pioneer sustainable urban districts. Powered by a 10 MW utility-scale solar PV plant and 1 MW rooftop installation, Masdar City generates approximately 19,100 MWh annually while displacing 15,000 tonnes of CO_2 each year, supporting the UAE's clean-energy transition[78]. Masdar City also serves as a global innovation hub, hosting more than a thousand clean-tech and climate-tech companies and acting as a launchpad for renewable-energy projects developed by Masdar, which is active in 40+ countries with a portfolio exceeding 20 GW.

Mobility upgrades are accelerating through AI-driven traffic control, smart intersections, and autonomous-vehicle pilots on Yas and Saadiyat Islands, where self-driving shuttles use advanced perception to enhance safety and ease congestion. Abu Dhabi is also scaling EV-charging infrastructure to support national net-zero goals. In 2024, the public network handled 90+ million bus rides and 168,000 water-transport trips, with 82% of residents reporting satisfaction—clear evidence that the city's mobility strategy is delivering results.[79]

In energy and utilities, Abu Dhabi deploys advanced metering, AI-based predictive maintenance, and smart grids. Large-scale projects—including the 2 GW Al Dhafra Solar Plant and the UAE Wind Program—reinforce the emirate's leadership in renewable-energy deployment and climate adaptation.

Economically, Abu Dhabi is investing USD 3.3 billion to develop the world's first AI-native city by 2027[80], embedding artificial intelligence into planning, governance, infrastructure, and economic clusters. Innovation hubs such as Hub71, the Advanced Technology Research Council, and the Smart Cities Lab support deep-tech entrepreneurship and accelerate the commercial adoption of emerging technologies.

[77] DGE (2024), You're a community voice

[78] Masdar factsheet

[79] Abu Dhabi's Smart Evolution: How the Capital Ranks Top 5

[80] Inside Abu Dhabi's $3.3B Smart City Revolution

Figure 19

Abu Dhabi – AI-Native Governance and Sustainable Innovation: Key Initiatives and Achievements

Sources: Department of Government Enablement (2025); Abu Dhabi Media Office (2024–2025); ITC Abu Dhabi (2024); TomTom Traffic Index (2024); IMD Smart City Index (2025); Masdar Corporate Factsheet (2024).

Strategic Area	Flagship Initiatives / Policies	
Digital Governance & Citizen Experience	**TAMM unified platform –** 1,100+ public and private sector services	**Government Data Management Standards –** enterprise-wide quality and interoperability.
	Abu Dhabi Digital Strategy 2025–2027 – integrated AI, cybersecurity, data governance.	
AI, IoT & Predictive Systems	**AI-powered inspection** robots for parks and public facilities	**Predictive analytics** for water and energy optimization
	IoT sensor networks for air quality, safety, and environmental monitoring	
Sustainable Development & Clean Energy	**Masdar City –** global hub for sustainability; 10 MW PV + 1 MW rooftop solar (~19,100 MWh/year)	**Al Dhafra 2 GW Solar Plant –** world's largest single-site solar facility
Mobility & Public Safety	**Autonomous-vehicle pilots** (Yas Island, Saadiyat Island).	**Expansion of EV** charging and sustainable mobility
	AI traffic prediction and emergency-response integration.	
Innovation Ecosystem	**Smart Cities Lab**, Abu Dhabi Innovation Accelerators. Hub71: global deep-tech and AI hub.	**ADSW**, Zayed Sustainability Prize – global climate platforms

Amsterdam: From Pilot Projects to Citizen-Centric Urban Innovation

3.2.7

Amsterdam stands out as a global model of human-centered innovation, where technology, ethics, and citizen collaboration converge to create a truly inclusive and sustainable smart city

Figure 20

General overview - Amsterdam

Country	The Netherlands
Population of the city	936,502
City Area (km2)	219,4
Population density	4,255 /km2
GDP per capita	USD 91.375
Average Monthly Salary	USD 5,103
IMD Smart City ranking 2025	17th Place
TOMTOM traffic index ranking	136th Place (Travel time over 10 km - 22 min 36 sec)

Practical Insights: Amsterdam proves that a smart city's real strength lies in how people use technology, not how much of it exists. Its open-data and algorithm-transparency models make governance more accountable, while the city's living labs show how residents can co-design practical solutions – whether for clean mobility or energy savings. Instead of chasing large-scale infrastructure projects, Amsterdam focuses on replicable, low-cost pilots that can scale fast through partnerships. For policymakers elsewhere, the key takeaway is simple: build frameworks that reward collaboration, protect trust, and deliver visible local benefits – that's how digital innovation becomes everyday governance.

Amsterdam is widely regarded as **one of the early pioneers of the smart city movement**. Its journey illustrates how digital innovation can evolve from experimental technology pilots into a coherent, citizen-centric urban ecosystem. Rather than focusing solely on hardware deployment or large-scale automation, Amsterdam's strategy emphasizes open data, cross-sector collaboration, and community participation – transforming the city into a living laboratory of digital sustainability.

The foundation of Amsterdam's smart transformation lies in the **Amsterdam Smart City (ASC) initiative**, launched in 2009 as a public–private partnership between the Amsterdam Economic Board, the Municipality of Amsterdam, grid operator Alliander, and knowledge institutions.
Its governance model is deliberately decentralized: rather than a single "smart city authority," Amsterdam operates through a network-based innovation platform that promotes collaboration and experimentation. Since 13 September 2024, the platform has been re-branded and renamed Amsterdam InChange, reflecting a shift in focus towards deeper collaboration and social innovation.

This flexible framework enabled the city to test and scale more than 250 pilot projects across mobility, energy, circular economy, and governance. For instance, the Climate Street[81] project in the early 2010s introduced smart meters, energy-efficient lighting, and waste-collection sensors in the retail corridor of Utrechtsestraat. Subsequent programs – such as the Smart Lighting Grid, Flexible Power Amsterdam, and City-Zen – applied IoT and data analytics to optimize energy use and reduce CO_2 emissions.

Crucially, these projects were designed to be replicable and interoperable, with lessons shared through the **Amsterdam Data Exchange and the European Innovation Partnership on Smart Cities.** This approach marked a shift from one-off pilots toward systemic learning and scale-up.

Amsterdam is recognized as one of Europe's early adopters of open-data practices. The city began developing its open-data infrastructure in 2012 through the Open Data Exchange initiative, and later launched the current municipal Open Data Portal (data.amsterdam.nl) in 2016. Today, the portal provides thousands of datasets across domains such as mobility, environment, housing, and public services, enabling access for citizens, researchers, and start-ups. Amsterdam's open-data ecosystem has supported numerous civic-tech and citizen-science initiatives, including community-driven air-quality monitoring projects (such as the Urban AirQ program run with residents) and digital platforms for reporting local issues. Together, these initiatives reflect the city's long-standing commitment to transparency, participatory innovation, and data-driven urban governance.

In recent years, Amsterdam has moved decisively toward ethical and responsible digitalization. The TADA (Ta-da – Data Disclosed) Manifesto, developed around 2017-2018[82] in collaboration with residents, businesses and academia, articulates **six core principles for the city's data ecosystem: control, inclusive design, being tailored to people, legitimacy & monitoring, openness/transparency, and shared data-for-everyone.** In September 2020 the City of Amsterdam became among the first municipalities worldwide to publish a publicly accessible algorithm/AI register detailing the use of automated systems in municipal services.[83] These steps form the core of the city's digital-ethics framework, which is now cited by the Cities Coalition for Digital Rights and other international initiatives as an example of municipal-level governance for data and algorithms.

[81] Amsterdam Smart City
[82] Reclaiming the Smart City
[83] Algorithm Registers: A Box-Ticking Exercise or Meaningful Tool for Transparency? - Esther Nieuwenhuizen, 2024

Figure 21

Amsterdam – Citizen-Centric Governance: Key initiatives and Achievements

Source: Amsterdam Economic Board (2024); Amsterdam Smart City Platform (2024); City of Amsterdam Open Data Portal

Strategic Area	Flagship Initiatives / Policies		
Governance & Collaboration	**Amsterdam Smart City (ASC) –** open innovation network with 400+ partners across sectors	**Hundreds of smart-city pilots since 2009** implemented across energy, mobility, digital services, and circular systems	
	Amsterdam Economic Board – convenes city, academia, and business on smart policy priorities		
Open Data & Digital Ethics	**Amsterdam Data Portal –** 2,000+ public datasets across domains	**Algorithm Register (2020) –** first public database of municipal algorithms in the EU	
	TADA Manifesto – ethical data framework co-created with residents		
Energy & Circular Economy	**City-Zen & Smart Grid Amsterdam –** data-driven district heating and microgrid pilots	**V2G (Vehicle-to-Grid) pilot –** enables energy feedback from EVs to the grid	
	Circular 2025 Strategy – aims for 50% reduction in raw-material use by 2030 and full circular economy by 2050		

Strategic Area	Flagship Initiatives / Policies	
Mobility & Environment	**Smart Traffic Management –** IoT-enabled optimization of traffic flow	**Cycling Network** - one of the world's densest cycling systems with over 800,000 bicycles in daily use
	Electric Mobility Plan 2030 – targets 75% of new cars electric by 2030 and zero-emission city centre by 2030	
Citizen Participation	**Living Lab Program –** co-creation platforms linking residents, SMEs, and researchers	**Urban AirQ –** community-driven air-quality monitoring initiative
	Amsterdam Reporting Portal – municipal app for real-time issue reporting	

Common Pitfalls and Lessons Learned

3.3

Governance fragmentation, weak interoperability, low citizen trust, and unstable funding remain the most frequent causes of smart-city underperformance

Over the past decade, hundreds of cities worldwide have experimented with digital technologies – AI-driven traffic control, sensor-based energy management, and predictive maintenance. Yet only a handful have successfully evolved these projects into fully integrated urban platforms.

The underlying causes are rarely technological. Evidence from comparative studies by the OECD (2023)[84] and UN-Habitat (2022)[85] shows that smart-city projects most often stall due to institutional fragmentation, data incompatibility, and insufficient fiscal or regulatory capacity. Similarly, longitudinal analyses of early smart-city programs in Europe found that many pilot projects “fade out” before replication – not because they fail technically, but because governance frameworks and performance metrics are misaligned[86].

[84] OECD (2023). Smart City Data Governance Report
[85] UN-Habitat (2022). Global Review of Smart City Governance Practices
[86] Smart City Pilot Projects: Scaling Up or Fading Out? Williem van Winden (2016)

Figure 22

Five Structural Pitfalls

Source: AIFC analysis

Pitfall	Structural Challenge	Global Example	Lesson from Global Leaders
Fragmented governance	Different city agencies start digital projects on their own, which leads to overlapping and poor coordination	In early phases, Amsterdam's departments experimented with isolated pilots under separate programs, limiting integration and scaling	Zurich, Singapore, and Dubai resolved this by establishing unified smart-city offices or digital authorities to align priorities and budgets across sectors
Weak interoperability	Data and software from one system often cannot connect to others	Copenhagen faced interoperability challenges when integrating climate, mobility, and energy datasets across agencies	Cities like Singapore and Seoul adopted common data standards and open APIs to ensure compatibility and cross-agency analytics
Limited public trust and Data ethics	Public concern over data privacy, surveillance, or opaque algorithmic decision-making undermines participation	Toronto's Sidewalk Labs initiative was discontinued amid concerns over data ownership and commercial control. Similar issues appeared in Songdo (South Korea), where residents questioned pervasive surveillance	Amsterdam's TADA Manifesto and algorithm register, and Zurich's transparent data charters, show how explicit governance of digital ethics can sustain trust and accountability
Short-Term or Project-Based Funding	Many initiatives depend on temporary grants or vendor contracts, stalling when initial funding expires.	Early EU-funded pilots in smaller cities lacked continuity beyond their grant cycles	Seoul and Copenhagen finance smart-city programs from regular multi-year municipal budgets, ensuring stability and continuity across administrations
Technology metrics over outcomes	Cities often measure device deployment instead of real improvements	Initial mobility and IoT programs in Copenhagen emphasized technology-rollout indicators rather than emission reductions or mobility-efficiency gains	Copenhagen, Zurich, and Singapore shifted to outcome-based KPIs tied to measurable CO_2 reductions, mobility efficiency, and citizen satisfaction

From Fragmentation to Integration: Lessons from Global Leaders

Across diverse contexts, the experience of leading cities demonstrates that technological progress alone does not determine success – institutional maturity does. Cities that have managed to transition from isolated digital pilots to integrated, city-wide systems share a set of structural enablers that make innovation both scalable and sustainable.

Figure 23

Five Key Enablers of Scalable Smart-City Transformation

Source: AIFC Industry Analysis based on IMD (2025), OECD (2023), UN-Habitat (2022), and city-level smart governance reports

Integrated Governance

Unified leadership structures that align technology, finance, and planning

Zurich, Singapore, Dubai

Standardized and Interoperable Data Systems

Common data standards and open APIs to avoid fragmentation

Seoul, Singapore

Stable, Outcome-Based Financing

Long-term budget integration and performance-linked funding

Copenhagen, Seoul

Citizen-Centric Trust Frameworks

Digital ethics, algorithm transparency, and clear data rights

Amsterdam, Zurich

Capacity and Skills Development

Investment in public-sector digital literacy and data management

Singapore, Seoul

Implications for Emerging Economies and Kazakhstan

For emerging economies — including Kazakhstan — global evidence shows that smart-city transformation succeeds not simply through new technologies, but through strong governance, institutional coordination, and predictable long-term financing frameworks. Countries that effectively scale pilot projects into integrated urban systems typically operate within coherent national–municipal architectures that align fiscal, regulatory, and innovation policies. Ensuring that digitalization efforts support broader economic diversification, environmental goals, and social inclusion has proven essential for sustaining momentum and attracting private-sector participation.

In Kazakhstan, ongoing reforms in digital public services, municipal management systems, and infrastructure modernization create a solid base for advancing smart-city agendas. Greater coherence between national initiatives and municipal implementation could strengthen consistency across urban programs. Developing interoperable data platforms, unified technical standards, and shared digital public infrastructure would reduce fragmentation and enable more efficient cross-city analytics and service delivery.

Diversifying financing sources is equally important. Expanding the use of blended finance, green and sustainability-linked bonds, infrastructure funds, and performance-based public–private partnerships can help meet the capital requirements of large-scale urban innovation. Such mechanisms are increasingly central to global smart-city projects, especially in emerging markets where municipal borrowing capacity is limited.

International experience also emphasizes the value of embedding privacy safeguards, transparent data governance, and ethical frameworks into digital infrastructure from the outset. These practices strengthen public trust and ensure that technology adoption remains human-centered. At the same time, gradual development of municipal capabilities — in data governance, project preparation, financial modeling, and asset management — enables cities to effectively plan, deliver, and scale digital infrastructure over the long term.

Taken together, these factors underscore the importance of an enabling environment in which policy alignment, financial innovation, and institutional capacity reinforce one another. Within such a framework, Kazakhstan's cities will be well positioned to evolve from isolated pilot projects to fully integrated smart-city ecosystems that generate sustained social, economic, and environmental value.

Kazakhstan's Smart City Transformation: **From Digital Policy to Implementation 4.0**

Over the past decade Kazakhstan has shifted from scattered "smart" pilots to a deliberate, KPI-driven transformation that now treats the city as a platform and the region as the real unit of scale. The storyline is simple: national digitalization built the backbone, municipalities learned to turn data into operations, and regions are beginning to stitch these capabilities into one operating picture. The next chapter – already starting in Astana and Almaty – pairs AI analytics and digital twins with clear service outcomes and funding models that can attract private capital.

Urbanization Trends and City Challenges in Kazakhstan

4.1.1

Kazakhstan is now a predominantly urban country. As of September 1st, 2025, roughly 12.7 million of 20.3 million residents live in cities (63%) and the urban share is inching up every year as internal migration favors jobs and services in regional centers[87]. The pattern is polycentric, not metropolitan: regions like Karaganda (~82% urban), Ulytau (~79%), and Aktobe (~76%) already look like mature industrial-urban systems, while Turkistan (~25%) and Almaty Region (~19%) remain far more rural in settlement patterns. That asymmetry explains why Kazakhstan's strategy is evolving from "smart city" to smart region: low-density territories need territorial coverage (connectivity, emergency response, social services on the move), not just downtown apps.

[87] Population of the Republic of Kazakhstan

Figure 24

Urban and rural population in Kazakhstan, 1991-2025

Source: National Statistics Committee

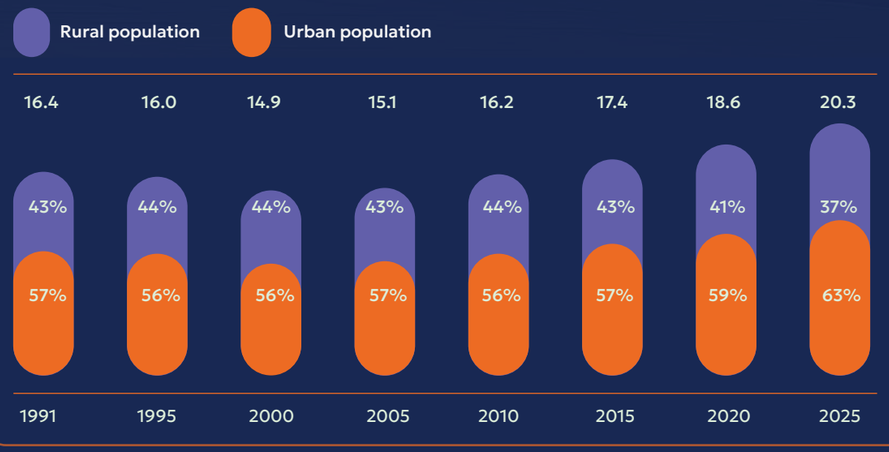
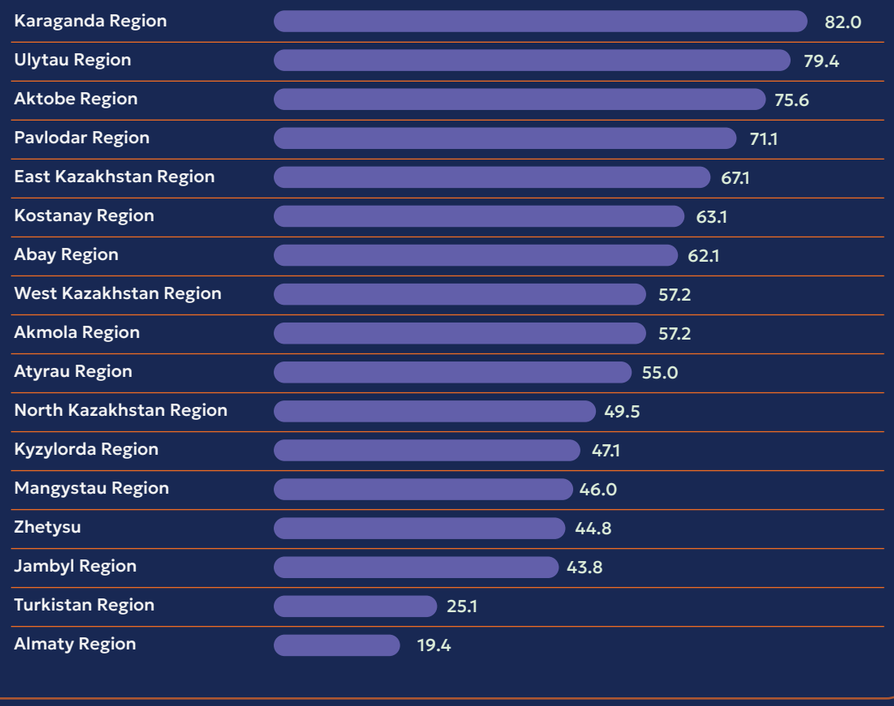


Figure 25

Urban population share by regions, 2025, in %

Source: National Statistics Committee



With growth come familiar urban challenges – congested corridors, patchy utilities, uneven public safety, and rising expectations for digital public services. Yet the binding constraint is not a lack of sensors or algorithms. It is fragmentation: systems that do not talk to each other, processes that were never redesigned, and budgets that reward pilots more than city-wide results. Kazakhstan's shift to process re-engineering, shared data models, and scorecards directly targets those constraints, encouraging city administrations to define outcomes up front and to prove impact with numbers of residents can understand.

The geography of people is shifting in tandem. Internal migration has tilted decisively toward the largest cities and a handful of dynamic regional centers: Astana, Almaty and Shymkent all posted positive net inflows in recent releases, (Fig.26) with the national statistics agency noting a marked increase in intra-country moves through 2024–2025.

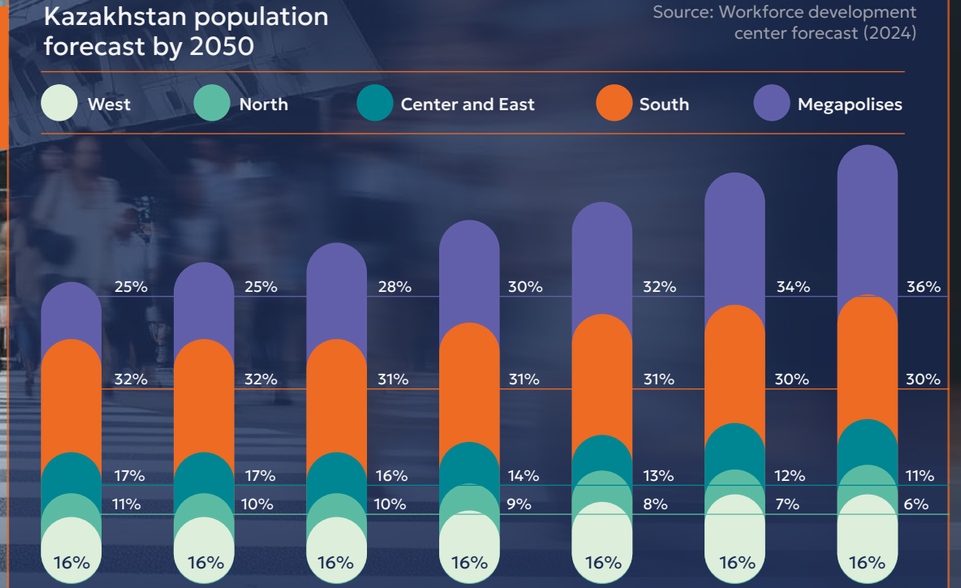
For urban managers, this presents a dual challenge: while expanding labor and consumer bases strengthen local revenues, the pressure on utilities, transport, housing, safety, and digital public services is rising faster than existing systems can effectively accommodate.

Figure 26

Dynamics of the population in major cities in the last 10 years, in thousands

Source: National Statistics Committee

Figure 27



Urban Population
Growth and Megacity Expansion

4.1.2

Kazakhstan's long-term demographic outlook reinforces this trajectory. According to projections by the Center for Human Resources Development[88], the country's population will rise from 20.2 million in 2024 to 27.6 million by 2050, with almost all growth absorbed by cities. The urban population is set to expand by 57% (from 12.3 million to 19.3 million), while the rural population will grow by just 8.5%. By mid-century, nearly 68% of Kazakhstan citizens will live in urban areas.

Growth will concentrate in megacities and dynamic southern and western regions, while northern and central-eastern areas face gradual decline. Megacities - Astana, Almaty, and Shymkent are expected to add nearly five million residents, increasing their combined share of the national population from 25% to 36% by 2050. The southern macroregion will gain around 1.9 million people, and the west about 1.3 million, while the north and center-east may collectively lose roughly 750,000 inhabitants.

Since 2000, Astana's population has grown 3.5-fold, Shymkent's by 2.6-fold, and Almaty's by two-fold, together adding 2.9 million residents – equivalent to one-quarter of the nation's total population. Their combined population is projected to reach 6.9 million by 2035 and almost 10 million by 2050[89].

This demographic momentum underpins Kazakhstan's smart city transformation. As cities expand, the pressures on infrastructure, utilities, and service delivery intensify.

Smart technologies – IoT sensors, AI analytics, and digital twins – are becoming essential tools for managing growth, optimizing resources, and ensuring transparent governance.

The national shift from "smart city" to "smart region" reflects the need to extend these digital capabilities beyond metropolitan cores, enabling integrated service delivery across the entire territorial network.

[88] Center for Workforce Development (CWRD). "Long-Term Demographic Forecast of Kazakhstan." December 2024

[89] Center for Workforce Development (CWRD). "Long-Term Demographic Forecast of Kazakhstan." December 2024

Urban Digital Transformation Challenges and Constraints

4.1.3

Kazakhstan's progress toward smarter, data-driven cities continues to be shaped by structural and institutional realities rather than purely technological capacity. While national policy has evolved – including the September 2025 adoption of the Methodology for Building "Smart" Cities (Reference Standard) – many of the foundational barriers remain. Three interrelated challenges continue to define the country's urban transformation: fragmented governance and data silos, a shortage of skilled professionals and research collaboration, and a narrow, state-dominated financing model.

01 Fragmentation and Data Silos

One of the key challenges in advancing smart city policy in Kazakhstan lies in the fragmented nature of the current IT landscape. The issue is not a lack of technology, but rather the coexistence of numerous isolated and non-integrated systems. Over time, different stakeholders and municipal departments have independently implemented customized digital solutions to address specific operational needs. In the absence of unified digital policy frameworks and interoperability standards, this has resulted in a patchwork of separate databases, proprietary software, and legacy platforms that operate without full compatibility.

This fragmentation limits the ability to create a comprehensive, real-time view of city operations — a foundational requirement for effective smart city management. As a result, urban command centers often function as data visualization tools rather than integrated decision-support platforms. Without system-wide data integration, it becomes difficult to scale pilot projects, automate responses, or generate actionable insights that can drive long-term efficiency and value across the entire urban ecosystem.

02 Talent Shortage and Limited Research Collaboration

Scaling Kazakhstan's digital-urban agenda will require sustained investment in workforce skills and capacity. To meet rising demands for complex systems integration and management, a larger pool of professionals in data analytics, AI, GIS, and cybersecurity are needed.

Universities are expanding digital-skills programs, yet collaboration between academia and industry is still limited. Few municipal or corporate projects involve universities in applied research, pilot design, or data analysis. This disconnect restricts innovation and reinforces dependence on imported expertise.

Kazakhstan's next stage of progress will depend on stronger university–industry partnerships, joint research programs, and fellowship schemes that link students, start-ups, and city authorities. Building a domestic knowledge base is critical for long-term independence and innovation.

03 Limited and Unbalanced Financing Models

Smart-city investment in Kazakhstan remains primarily concentrated within B2G (business-to-government) procurement frameworks. Most initiatives are financed through public budgets, while private capital participation is still emerging.

Short project horizons, limited use of performance- or outcome-based contracts, and reliance on state-funded tenders can dampen incentives for innovation and lifecycle efficiency, leading vendors to optimize for annual budgets rather than long-term operations.

Digital Transformation and **Urban Strategy**

4.2

Kazakhstan's smart city transformation has matured into a coherent national framework that aligns digital infrastructure, governance, and measurable performance. The strategy follows a structured sequence: build national digital capacity, operationalize it at the city level, and scale across regions. This marks a decisive shift from project-based digitalization toward outcome-driven urban management.

Kazakhstan enters this phase with solid digital credentials. Ranked 24th globally (EGDI 0.9009) in the UN E-Government Development Index 2024 and 27th in E-Participation[90], the country leads Central Asia in both institutional digitalization and citizen engagement. More than 90% of residents have internet access, and e-services have become standard in most interactions between citizens and government. Combined with a nationwide 5G rollout - supported by over KZT 450 billion in planned operator investments through 2027[91], - these capabilities create the foundation for dense IoT, AI, and data-driven operations across all major cities.

At the policy level, Kazakhstan's Smart City Methodology, formally approved in September 2025, anchors this transition. It establishes standardized rules for digital transformation, replacing ad-hoc project tracking with quantified KPIs that measure service delivery, data latency, and operational efficiency. Municipalities are now evaluated through transparent and comparable performance indicators, turning digitalization into a governance and accountability framework rather than a technology checklist.

The emerging Smart Region model extends this logic beyond city boundaries. Regional control centers integrate mobility, utilities, healthcare, and public safety systems into shared data lakes—enabling interoperability, coordination, and system-wide efficiency across Kazakhstan's polycentric urban landscape.

Institutional reform is now being complemented by scalable financing models. The US$190 million AI and digital-twin partnership between Astana and Presight exemplifies a new generation of platform-based investments that align funding, KPIs, and public outcomes.

In essence, Kazakhstan's digital transformation is entering an investable phase. Strong e-governance performance, top-tier citizen e-participation, and a unified smart-city methodology create a transparent environment for international investors. With a robust digital backbone, standardized governance, and scalable platforms, Kazakhstan is emerging as one of the most attractive and structured smart-city ecosystems in the Eurasian region.

[90] UN E-Government Survey 2024

[91] Prime Minister's official website

Astana International Financial Centre

Digital Services and Citizen Platforms: Everyday Smart Living

4.3

Kazakhstan's progress toward a smarter urban future is most visible in the everyday digital experiences of its citizens. Over the past decade, the country has built one of Central Asia's most advanced ecosystems of online public and private services, where daily life increasingly unfolds through digital platforms. From obtaining government documents and managing healthcare to paying bills, shopping, or navigating the city, residents can now complete most essential activities from a smartphone.

The foundation of this ecosystem is the Electronic Government (eGov) platform, which provides more than a thousand digital public services through its unified portal and mobile app. Citizens can apply for birth or marriage certificates, register vehicles, pay taxes, and access social benefits entirely online — often without visiting public offices. The system integrates digital identification, electronic signatures, and open-data tools that connect public databases into a single, transparent interface. The eGov mobile app has become a model for digital governance in the region, making administrative services accessible to millions of users and reducing bureaucratic complexity.

In the health sector, the Damumed ecosystem has transformed how people interact with the medical system. It consolidates patient records, doctor appointments, laboratory results, prescriptions, and vaccination history into a single patient-oriented platform. Citizens can schedule consultations, monitor treatment progress, and receive preventive notifications remotely, while clinics use the same system for digital reporting and analytics. Damumed represents a shift from fragmented medical administration toward proactive, data-driven healthcare.

Smart mobility has also redefined the urban experience. A wide range of digital platforms now enable residents to rent scooters, bicycles, or cars on demand, while public-transport applications provide real-time bus tracking and multimodal route planning, helping residents and visitors discover services and move efficiently through urban environments. Food delivery, grocery shopping, and parcel services have likewise become integrated into unified mobile ecosystems, allowing users to combine transportation, logistics, and retail functions within a single digital environment. This growing network of interconnected services not only enhances everyday convenience but also supports environmental sustainability by reducing congestion, encouraging shared mobility, and optimizing urban logistics.

The financial sector has likewise embraced digital transformation, becoming one of the most dynamic components of Kazakhstan's smart-service landscape. Banking applications have evolved into multifunctional platforms that integrate payments, money transfers, credit services, insurance, and online shopping within a single interface. Users can now pay bills, manage investments, purchase goods, and arrange same-day delivery directly through their mobile apps. This convergence of financial and retail services has accelerated the spread of cashless payments, strengthened digital inclusion, and positioned fintech innovation as a key enabler of Kazakhstan's smart-economy ecosystem.

Beyond these sectors, an expanding array of digital applications continues to enhance daily life for residents - from online education and remote work platforms to housing-management systems, digital marketplaces, and environmental monitoring tools. As these services mature and interconnect, Kazakhstan's cities are evolving into comprehensive digital ecosystems that anticipate citizens' needs and deliver integrated, data-driven experiences. Together, these innovations reflect a broader transformation: technology sits at the heart of urban life in Kazakhstan, shaping how citizens live, work, move, and interact.

National Smart-City Methodology: **What It Is, How It Works, Why It Matters**

4.4

Kazakhstan's smart city agenda reached a major milestone in September 2025, when the Ministry of Artificial Intelligence and Digital Development approved the Methodology for Building Smart Cities (Reference Standard), set to take effect on 1 January 2026. The decision transformed "smart city" from a policy ambition into a rules-based national framework—embedding digital governance standards directly into law and operational practice.

The methodology defines a smart city as an integrated system of **technological and organizational measures** aimed at improving service quality, optimizing resource use, and strengthening competitiveness. It is anchored around three strategic objectives:

01 **Safe and comfortable living**

02 **Effective city management**

03 **Urban competitiveness and sustainability**

These objectives are underpinned by six guiding principles — human-centricity, sustainability, transparency, inclusion, innovation, and interoperability — ensuring that digital progress translates into measurable social and economic value.

Aligned with leading global standards (ISO 37120, U4SSC, BSI PAS 181, CityScore), the framework provides a common reference point for local municipalities and a comparable baseline for investors and lenders. It requires each city to prepare a Smart City Strategy and Implementation Roadmap with clear targets, responsible owners, and timelines.

At its foundation, the methodology formalizes data integration and evidence-based decision-making. All municipal systems - from contact centers and payment hubs to transport and safety platforms - must connect through the Smart Data Ukimet (SDU), the national data platform. This ensures that all performance metrics are generated from live data, eliminating manual reporting and enabling real-time management, predictive analytics, and data consistency across sectors.

Performance is measured through CityScore-Kazakhstan, a composite index modeled on leading global practices. Updated daily, weekly, or monthly from SDU data feeds, it evaluates cities on operational KPIs such as data latency, first-contact resolution, and digital payment throughput. Results feed into an annual national ranking and analytical report, creating a transparent feedback loop that enables benchmarking and continuous improvement.

The roadmap's baseline initiatives make Kazakhstan's smart city program both actionable and investable. From city situation centers and unified contact platforms to integrated transport control and IoT-based smart metering, every measure includes clear functions, responsible agencies (akimats, utilities, emergency services, ministries), and defined outcome metrics.

- **For government authorities,** this converts digitalization into management by measurable results and a predictable rollout calendar.
- **For investors and PPP partners,** it reduces due diligence costs and provides visibility on where multi-year platform contracts or data-infrastructure investments can be attached.

A near-term priority is to strengthen procurement standards requiring open APIs and shared data models. This ensures that modules developed in Astana or Almaty can be replicated seamlessly across regional centers without costly redevelopment - a principle embedded in Methodology's SDU integration rules.

From a governance perspective, the framework institutionalizes the principle of "build once, reuse everywhere." A single KPI framework, open-interface mandate, and continuous CityScore updates mean that projects are evaluated on verifiable results - such as response times, billing throughput, or first-contact resolution — rather than assumptions or projections.

For city leaders, this creates a single operating canvas - one view of performance across departments and regions, enabling agile resource allocation and data-driven decision-making. For investors, it establishes a transparent and scalable smart city market with measurable performance, replicable platforms, and standardized contracts

In essence, the new Smart City Methodology transforms Kazakhstan's urban digitalization into a governable, investable, and exportable model, positioning the country as one of the first emerging markets to codify smart city governance in law and align municipal innovation with global standards of accountability and efficiency.

What Works Where: Comparative Readout on Astana, Almaty, and Regional Initiatives

4.5

Kazakhstan Smart City ranking

4.5.1

Kazakhstan's Ministry of Digital Development, Innovation and Aerospace Industry (now "Ministry of Artificial Intelligence and Digital Development") has released the national Smart City Ranking for 2024, providing a comprehensive assessment of how cities are integrating digital technologies into urban management and public service delivery. The ranking, published on 9 June 2025, evaluates 20 municipalities across key dimensions of smart governance, infrastructure, and citizen engagement.

Figure 28

Kazakhstan smart city ranking 2024

1	Astana
2	Almaty
3	Karaganda
4	Kostanay
5	Ust-Kamenogorsk
6	Uralsk
7	Kyzyl-Orda
8	Pavlodar
9	Taldykorgan
10	Shymkent
11	Petropavlovsk
12	Turkestan
13	Atyrau
14	Konaev
15	Aktobe
16	Kokshetau
17	Taraz
18	Semey
19	Zhezkazgan
20	Aktau

Source: Ministry of Artificial Intelligence and Digital Development

Astana, Almaty, and Karaganda lead the 2024 index, followed by Kostanay and Ust-Kamenogorsk, while Aktau ranks lowest. The results underscore a systematic shift from fragmented pilot projects toward integrated, platform-based city management, signaling growing institutional and technological maturity across Kazakhstan's urban landscape.

Across major cities, digital tools have moved beyond experimentation into daily use. Widespread adoption of e-school diaries, online medical booking systems, contactless fare payments, real-time public transport tracking, and the 109 citizens contact center demonstrates that digital transformation is becoming embedded in core municipal functions. The expansion of CCTV networks and citywide monitoring systems further supports evidence-based decision-making and public safety outcomes.

Artificial intelligence (AI) is now a visible driver of next-stage innovation. In Almaty and Karaganda, AI-based road-condition monitoring produces digital pavement maps that guide maintenance and investment decisions. In seven regions – including Abai, Almaty, Atyrau, East Kazakhstan, Jetisu, Karaganda, and North Kazakhstan – AI applications support early cancer diagnostics through automated analysis of radiological and medical imaging data. These initiatives mark Kazakhstan's transition toward data-driven and predictive urban management.

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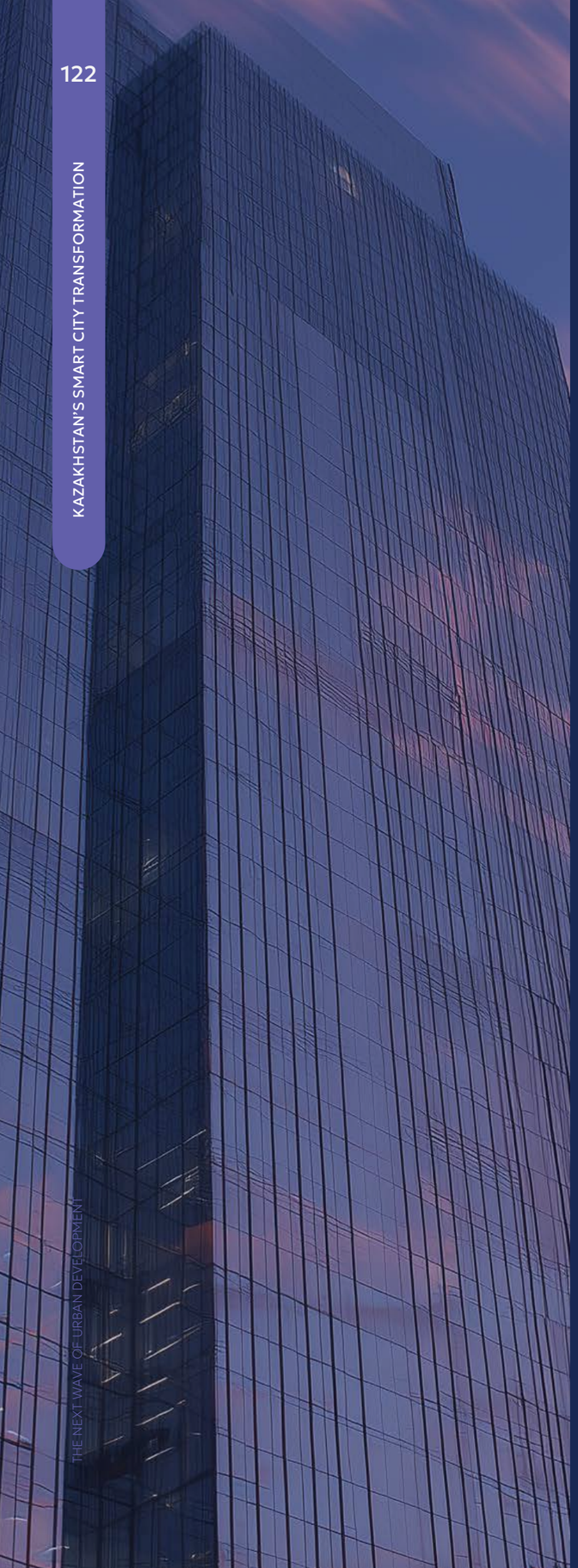
Astana

4.5.2

Astana's 'Smart City' project is centered on creating a centralized, AI-driven urban management system. The core of this strategy involves a high-tech Situation Center designed to support rapid, data-driven decision-making. This system integrates advanced artificial intelligence to monitor traffic, enhance public security, and unify disparate city services.

A key component is the large-scale implementation of new technologies for physical security information management (PSIM) and advanced video analytics. This initiative is expanding the city's extensive surveillance network, which already includes over 22,000 cameras, into a single, unified digital ecosystem to improve emergency response and city operations.



Strategy:
manage to outcomes, not to gadgets

Astana's approach mirrors Kazakhstan's national methodology: measure what residents feel – response times, reliability, safety, and convenience – and hold operators to quantified targets. The KPI book used across republican cities sets data-latency thresholds for situation centers (≤ 15 minutes), first-contact resolution bands for the 109+ contact center (≥ 80–90%), and minimum monthly payment throughput for the city's settlement hub (≥ 1 million for large cities)[92]. These are not vanity metrics; they are tied to refresh cadences, formulas and scoring rules, so managers can act on variance daily, weekly and monthly. The task is to contract and report against the same rules – turning digitalization into management by numbers.

[92] Appendix 4 to the "Roadmap for building smart cities in the Republic of Kazakhstan"

Supercomputing
as the Engine of Astana's Smart-City Architecture

Launched in July 2025, the National Supercomputing Center in Astana represents a critical leap in Kazakhstan's digital infrastructure — positioning the capital as the operational core of the country's data and AI ecosystem[93]. The center provides the high-performance computing (HPC) capacity required to power advanced analytics, simulation, and real-time decision-making across urban systems.

For Astana's smart city program, the supercomputing platform delivers three tangible advantages:

Enhanced computational capacity for real-time urban intelligence

The HPC infrastructure enables the city's digital twin and AI-based analytics to run complex, real-time models for traffic optimization, predictive maintenance, and public safety without limitations. This significantly strengthens operational responsiveness and system reliability.

Data sovereignty and secure AI development

By hosting computation and data processing within Kazakhstan's regulatory perimeter, the center supports AI sovereignty — ensuring that large Kazakh-language models, simulation environments, and sensitive city data remain securely managed within national jurisdiction. This reduces dependence on external cloud infrastructure .

Ecosystem enablement and innovation acceleration

The facility serves as a shared national resource for universities, start-ups, and public–private partners, providing access to scalable compute power for R&D, model training, and applied pilot projects. By aligning compute access with municipal needs, the center lowers entry barriers for innovators and accelerates the commercialization of digital solutions that can be redeployed across multiple urban domains.

Together, these capabilities make the National Supercomputing Center not only a technological backbone for Astana's digital twin and AI operations but also a strategic enabler of Kazakhstan's broader digital transformation — fostering innovation, ensuring data sovereignty, and creating a scalable foundation for intelligent, future-ready urban management.

[93] Presight AI official website

Institutional backbone: iKOMEK-109 and the situation centre

Astana's iKOMEK-109 is the citizen-facing front door for city services: one number, one interface, integrated with back-office departments and emergency services. It is the practical hinge between residents and the platform stack, and it is publicly documented as the city's unified contact centre. When paired with the situation centre and payment hub – and managed to the national KPI regime – 109+ turns complaints into structured cases, cases into datasets, and datasets into operational improvements that can be benchmarked across districts and months.

Finance and scale signals

Astana's transition from pilot initiatives to platform-based management is increasingly reflected in both budget allocations and strategic investment signals. In 2025, the city earmarked approximately ₸53 billion[94] for AI-enabled traffic management and public safety integration, underscoring a clear policy shift toward system-wide digital infrastructure rather than isolated projects.

At the same time, national telecom operators have pledged over ₸450 billion through 2027[95] to strengthen Kazakhstan's digital backbone and complete the 5G rollout that underpins the city's smart-infrastructure stack.

These parallel investments illustrate a well-coordinated approach: Astana funds the operational intelligence layer, while the national network provides the foundational "pipe." Together, they create a scalable and investable framework — aligning municipal innovation with national connectivity and sending a clear signal to investors that Kazakhstan's capital is building a sustainable, data-driven urban platform.

[94] The Astana Times - Astana Advances Smart City Project to Strengthen Public Safety
[95] The Astana Times - Kazakhstan to Ensure Nationwide Internet Access by 2027

Astana International Financial Centre

Public Transportation

4.5.2.1

Astana's public transportation system is being strategically developed as a core component of its 'smart city' framework, leveraging technology to create a more efficient, user-friendly, and sustainable urban environment. This effort is overseen by the city's transport operator, **City Transportation Systems (CTS).**

Key initiatives include the implementation of a modern Light Rail Transit (LRT) system to provide faster travel along the main corridors, with test runs now underway. On September 2025, the LRT entered pilot service trials in driverless (GoA4) mode, giving the city a predictable, high-capacity trunk (Airport-Left Bank-Nurly Zhol) that's designed from day one to feed real-time operations[96].

The rail network is complemented by a digitalized bus system featuring real-time vehicle tracking via mobile applications, electronic fare payments through transport cards and QR codes, and a network of heated "smart" bus stops equipped with video surveillance and Wi-Fi.

Operational efficiency is further supported by AI-assisted traffic management solutions and dedicated bus lanes, which help improve service reliability and reduce congestion. CTS also applies data analytics to passenger flow data to optimize routes and schedules.

As part of the city's broader smart city program, Astana has initiated the deployment of AI video analytics and digital-twin–enabled capabilities for traffic and urban operations under an agreement with Presight, supporting data-driven congestion management and incident response.

Finally, residents' reports and service requests flow through iKOMEK-109, the city's official 24/7 unified contact channel, which provides the dispatch/closure loop that connects riders, operators and the control room.

Together, electric buses, driverless LRT, AI-enabled traffic management, and integrated citizen feedback mechanisms transform public transportation from a collection of standalone projects into a measurable urban service. Key performance indicators such as punctuality, headways, incident clearance times, and corridor travel speeds can be systematically monitored and improved. Overall, these integrated digital solutions aim to increase public transport usage, reduce congestion, and enhance quality of life in the capital.

[96] The Astana Times - Kazakhstan Launches Pilot Operations of Astana LRT

Public Safety

4.5.2.2

In 2025, Astana initiated the transition of safety operations to an AI-assisted platform under an agreement with Presight, covering AI video analytics, PSIM, and a digital-twin–enabled control room for real-time situational awareness across traffic and public space[97].

By late August 2025, the city reported more than 22,000 cameras integrated with the Police Operations Management Center and over 1,200 connected hardware and software systems[98], indicating that multiple agencies are contributing to a unified operational view.

Citizen reports, hazards, and utility issues are routed through iKOMEK-109 (phone, web, and mobile app), the capital's 24/7 unified contact channel[99] positioned as the dispatch and closure loop for emergency and urban services, and the primary KPI surface for answer and response times.

The city is also piloting Sergek-by-drone: in June 2025 Astana introduced a UAV-assisted Sergek mode to track vehicles on wanted lists, expanding detections beyond fixed sites[100]. Complementary national measures (e.g., SafeTravel.kz SOS app; emergency hotline 112) bolster risk preparedness for residents and visitors, linking the public to police and rescue channels.

[97] Smart Cities World - City of Astana to deploy $190m AI-powered smart city project
[98] The Astana Times - Astana Advances Smart City Project to Strengthen Public Safety
[99] iKomekAstana
[100] Drone-based Sergek system introduced in Astana

Almaty

4.5.3

Almaty's smart-city transformation demonstrates how digitalization can directly improve the daily urban experience. The city has prioritized accessibility, mobility, and citizen engagement, translating national digital frameworks into measurable, people-centered outcomes.

One of the flagship initiatives is the **Inclusion Platform**, which has created over **38,000 digital passports[101] of public and social infrastructure**. Each facility is assessed across 100+ accessibility parameters, producing a transparent, data-driven picture of where upgrades are needed. Although currently only around 10–15% of audited sites fully comply with accessibility norms, this mapping exercise has enabled the city to quantify its modernization backlog and prioritize investment based on measurable needs. More than 8,000 specific recommendations now guide capital expenditures, allowing Almaty to link social policy with performance-based budgeting — a rare example of how digital infrastructure informs inclusive growth.

Operationally, Almaty's smart-city architecture integrates its situation center, **Almaty-109 unified contact platform**, and digital payment systems under a common KPI framework. This structure mirrors Kazakhstan's national Smart City Methodology but emphasizes local priorities: safety, mobility, and quality of urban services. Through Almaty-109, residents can report issues via phone, web, or chatbots; all cases are automatically routed to responsible departments and tracked against service-level agreements. As a result, feedback becomes structured data — and data, in turn, becomes actionable management insight.

Mobility remains the second pillar of Almaty's strategy. Under the Smart Almaty 2020–2025 program[102], the city has implemented adaptive traffic-light control, public transport signal priority, and real-time monitoring of network performance. Integrated data streams from the ONAY fare system, metro services, Sergek analytics, and 109 complaints provide a unified operational dashboard. The system enables officials to shift from reactive management to predictive traffic optimization, reducing congestion and improving travel reliability.

Almaty's approach to technology is pragmatic rather than experimental. The city employs computer vision and geospatial analytics to monitor road quality, prioritize repairs, and optimize public-space investments. The focus is not on deploying more devices, but on building a closed performance loop — from sensing to decision to spend — visible on dashboards accessible to managers and, increasingly, the public.

The result is a model that builds credibility with both citizens and investors. Residents benefit from faster response times, improved accessibility, and a transparent accountability structure, while investors see structured programs with clear metrics, timelines, and measurable returns. Importantly, Almaty mitigates common digital risks such as vendor lock-in by adhering to open APIs, shared data models, and standardized KPIs under the national Smart City framework.

This disciplined, human-centered, and interoperable approach positions Almaty as a national benchmark for scalable, outcome-driven urban management - where "smart" means not more technology, but better, measurable service for every resident.

[101] Almaty Development Center, Department of Digitalization of Almaty city, Department of Employment and Social Programs of Almaty on Infrastructure Day, October 10th 2025, Almaty, Kazakhstan

[102] Digital Almaty – "Strategy "Smart Almaty" for 2020-2025"

Public Transportation

4.5.3.1

The development of public transport in Almaty is a priority in the context of combating congestion and improving the environmental situation, as high rates of car ownership and the current system's low appeal are leading to a growing private vehicle fleet.

The "Smart Almaty" concept includes the implementation of a Transport Infrastructure Development master plan through 2030, which aims to shift up to 22% of residents from private cars to public transport[103]. Key smart solutions involve the introduction of intelligent traffic management systems, such as adaptive traffic lights that regulate green light timing based on real-time traffic flow, and digital route monitoring. Critically, the city has successfully implemented Onay, an electronic system that manages all public transit payments, standardizing fares and providing essential data for route optimization and financial transparency.

Although electronic ticketing and plans for developing a rapid transit network (including the metro and restoring the tram line) are underway, only 20% of traffic signals currently adapt their timing based on actual traffic demand, under 1% of public transit stops display dynamic real-time information, and just 4% of vehicles are low-emission[104] highlighting the need for further deployment and modernization of the fleet to low-emission vehicles.

Public Safety

4.5.3.2

The public safety sector in Almaty is actively being transformed through digital technologies and surveillance systems. The city is a pioneer in Kazakhstan for implementing a Unified Video Monitoring System, which covers a significant number of cameras. The system is designed to include complex safety systems in 220 schools, video surveillance of crowded places, of traffic, and in elevators[105].

Reports indicate that over 54,000 cameras are already connected, including more than 2,200 utilizing **facial recognition technology.** A crucial element in improving road safety is the Sergek system, an intelligent hardware and software complex that records traffic violations. Its deployment has reportedly contributed to a 20% reduction in traffic accidents and a 40% decrease in road fatalities across the city[106]. Furthermore, a Comprehensive Security System has been deployed in social facilities, such as schools, kindergartens, and medical institutions, featuring video analytics and automatic emergency alerts, significantly boosting institutional security.

[103] STEP City – Transport Framework for Rapid Public Transport in Almaty
[104] Lossi360 – Opinion | Almaty's smart city development is reinforcing urban inequality
[105] Department of Digitalization of Almaty city
[106] Kazinform International News Agency

Other cities' **measures to keep up**

4.5.4

Following the national "Digital Kazakhstan" program, several major cities are implementing "Smart City" technologies to improve public services, safety, and efficiency. While major centers like Astana and Almaty serve as blueprints, cities like Shymkent, Karaganda are adapting these technologies to their specific economic and geographic needs.

Shymkent (Smart Mobility & Services)

4.5.4.1

Shymkent's "Smart City" implementation has a strong focus on **intelligent transportation and public service digitization**. The city has recently rolled out one of the largest Intelligent Transportation Systems (ITS) in the region, equipping over 240 intersections with radar sensors and adaptive traffic lights to monitor traffic in real-time, reduce congestion, and improve road safety[107]. Similar to other major centers, Shymkent has also focused on digitizing education and healthcare, implementing electronic transport payment systems, and deploying the "Sergek" surveillance system for public safety. Future plans also include using drones for environmental monitoring and infrastructure management.

[107] Smart Mobility in Action: Shymkent Implements Intelligent Transport

Karaganda (Industrial & Utility Digitization)

4.5.4.2

As a major industrial hub, Karaganda's "Smart City" model is uniquely focused on the **digitization of industrial facilities and smart utilities.** The "Smart Karaganda" concept covers 11 key areas, including a "Smart Housing and Public Utilities" initiative to install smart meters for electricity, water, and heat to optimize consumption and reduce losses[108]. In recent years, Karaganda has been consistently ranked as one of the five "Smart Cities" in Kazakhstan, particularly for its successful adoption of unified public service contact centers (like the 109 "senim" service), electronic fare collection, and real-time GPS tracking for all public transport.

[108] gov.kz – Akimat of Karaganda region

Aqmola region

4.5.4.2

Akmola's 'Smart Region' initiative is being implemented as a direct response to key systemic challenges, including a fragmented IT landscape, a shortage of digital talent, and a lack of unified analytics. To solve this, the **Digital Transformation Map (2025-2030)**[109] introduces a new, centralized governance model. This framework is built around a central situational-analytical center and managed by a new 'Unified Operator' (Aqmola-Digital), supported by Chief Digital Transformation Officers (CDTOs) embedded in local administrations. This integrated system is now deploying high-priority AI projects, including an 'Ascle AI' assistant for medical transcription, an AI-driven platform for detecting road defects that has already processed data from over 400 km of roads, and a significant expansion of the Sergek video surveillance network, which is integrating 220 existing AI cameras with plans to add over 3,000 new ones by the end of 2025[110]. A system of drones is also planned to be used for the purposes of governance, ecological measures, rescue, and incident reaction.

[109] The implementation of the President's Address was discussed in Akmola Oblast.

[110] Digital Region – Model of region governance based on data | Digital Aqmola on Infrastructure Day, October 10th 2025, Almaty, Kazakhstan

Academic and Research Partnership

4.6

The evolution of Kazakhstan's smart-city ecosystem depends not only on technology adoption but also on the development of a robust knowledge and research base. Universities and academic centers play an increasingly strategic role in generating local expertise, conducting applied research, and supporting data-driven decision-making for municipal and regional governance. Strengthening these partnerships is critical to ensuring that Kazakhstan's smart-city transformation is sustainable, inclusive, and rooted in domestic innovation capacity.

A number of regional universities contribute to research on sustainable infrastructure, digital technologies, and smart-city solutions. Among the most prominent national centers driving this agenda are Astana IT University (AITU) and Nazarbayev University (NU), whose dedicated research institutions lead applied projects in artificial intelligence, data science, urban digitalization, and climate-resilient city systems.

Astana IT University (AITU)

Among the country's leading academic contributors is Astana IT University (AITU), which established the Smart City Research and Innovation Centre to unite scientists, innovators, and students in addressing practical challenges of urban digitalization. The Centre conducts applied research in artificial intelligence, big data, the Internet of Things, and automation for transport, environmental management, and energy efficiency. Between 2021 and 2023, it implemented projects focused on developing intelligent information and telecommunication systems for urban infrastructure, while also hosting innovation contests and training programs to involve students in real-world city analytics. Through such initiatives, AITU is building a bridge between academic research and municipal application, helping nurture a new generation of data-driven urban planners and digital engineers.

Nazarbayev University (NU)

Nazarbayev University (NU) also serves as a national research hub supporting digital transformation. Its Institute of Smart Systems and Artificial Intelligence (ISSAI) conducts interdisciplinary research on machine intelligence and data science to address real-world challenges in industry and society, including urban environments. NU's research ecosystem extends to international collaborations such as the Climate Change and Smart Cities in Central Asia (NETSTAN) initiative with RWTH Aachen University (Germany) and Tashkent State Technical University, focusing on climate-resilient and data-informed city models.[111] The university's graduate programs in data science and engineering further supply the technical skills essential for designing and maintaining smart-city systems.

Together, these institutions anchor the intellectual foundation for Kazakhstan's digital-urban agenda. They demonstrate how universities can serve as living laboratories, linking research and education with practical implementation. However, cooperation between academia, municipalities, and industry remains largely ad hoc. Most city-level digital projects still operate without systematic academic involvement, and universities have limited access to municipal datasets for research and experimentation. This constrains both innovation and policy learning.

To move forward, Kazakhstan's cities and universities must adopt a partnership-based innovation model: establishing formal research consortia for applied R&D, creating secure open-data environments for analysis, and embedding internships and fellowships that allow students to contribute directly to smart-city programs. Such measures would institutionalize knowledge exchange and build continuity between research, design, and execution.

[111] International Collaboration Launched to Develop Smart, Climate-Resilient Cities in Central Asia

Innovation Ecosystem and Business Incubators

4.7

The development of Kazakhstan's smart-city sector increasingly depends on the maturity of its innovation ecosystem – a network of business incubators, accelerators, and technology hubs that transform ideas into scalable urban solutions. These institutions connect research, entrepreneurship, and municipal demand, ensuring that technological innovation contributes directly to sustainable urban transformation.

Over the past five years, Kazakhstan has established several key innovation platforms. The flagship among them is **Astana Hub, the country's largest international techno park for IT start-ups,** created under the Digital Kazakhstan program. Astana Hub supports more than 1,200 resident companies[112], offering acceleration programs, tax incentives, and access to venture funding.

A core component of this ecosystem is the **Smart City Accelerator, a specialized program launched by Astana Hub in cooperation with city digitalization departments.** The accelerator selects early-stage technology teams to address urban challenges in areas such as mobility, utilities, public safety, and environmental management. Start-ups receive seed funding of up to 5 million KZT (~$9.500), mentorship from municipal experts, and opportunities to pilot their technologies in real urban environments. In 2024, the Astana Smart City Accelerator attracted more than 120 applicants, with ten start-ups selected for pilot implementation in Astana[113].

In 2025, the program was relaunched under a new format and named **Astana Innovations Accelerator** — as an intensive **two-month acceleration cycle** designed to fast-track technology solutions for urban development. This eight-week program culminates in a **Demo Day**, where the most promising start-ups compete for funding of up to **5 million KZT** (~$9.500) from **Astana Hub Ventures**. This updated structure reflects a shift toward performance-based selection and outcome-driven acceleration, ensuring that emerging technologies progress from prototype to implementation within the city's innovation ecosystem.

[112] Astana Hub 2024 results
[113] Astana Hub – "Smart City Accelerator: Ten Startups Selected for Pilots in Astana" (2024)

Another important initiative is the **Smart City Accelerator (SCA)** launched in Almaty by **MOST Business Intelligence,** Kazakhstan's first private business-incubator ecosystem[114]. The SCA focuses on start-ups addressing real urban challenges in transport, environment, infrastructure, and creative industries. The program is cohort-based, lasting around eight to nine weeks, and includes weekly traction sessions, mentoring, and investor-preparation workshops.

[114] MOST Business Intelligence – Smart City Accelerator Program

Together, these accelerators are fostering a new generation of urban innovators – linking entrepreneurial energy with public-sector needs and ensuring that Kazakhstan's smart-city agenda grows not only through technology acquisition but through locally developed, evidence-based, and commercially sustainable solutions.

Alatau City: Kazakhstan's Born-Digital Urban Hub

4.8

Official Vision & **Strategic Launch**

Alatau City is Kazakhstan's most ambitious "smart city" initiative, conceived as a "Territory of Advanced Development" to be built from the ground up, based on international best practices. It was officially designated as a new city of regional significance in January 2024. Formerly known as the "G4 City" project, Alatau City positions itself as not merely an extension of Almaty, but a standalone metropolis strategically located along the key Almaty-Konaev highway (a core segment of the "Western Europe - Western China" transport corridor). The project's primary strategic goals are to relieve demographic pressure on Almaty, create a new, globally competitive economic hub, and serve as a national testbed for innovation in urban planning, governance, and technology. The first official construction, the "K-Park" cultural and business center, broke ground on September 12, 2025.[115]

[115] Groundbreaking of K-Park. International Business Forum AI-4room

City Structure: **The Four Specialized Districts**

The Alatau master plan, developed by Singapore's Surbana Jurong, is polycentric. It is divided into four thematic, semi-autonomous districts, each with a distinct economic specialization[116]:

Gate District
Financial & Business Hub:

Almaty, this will be the primary administrative and commercial core. It is planned to feature a landmark, "Iconic Building-1" as an international business center.

Key Figures

Total Area: **3 988 hectares**
Industrial Area: **230 hectares**
Projected Population by 2050: **223 thousands**
Projected Jobs by 2050: **181 thousands**
Expected number of tourists by 2050: **up to 306 thous.**

Golden District
Knowledge & Medical Hub:

This district is dedicated to human capital, focusing on education (international universities), healthcare (a multidisciplinary medical cluster), and R&D. The "K-Park" is being built here.

Key Figures

Total Area: **15 660 hectares**
Industrial Area: **810 hectares**
Projected Population by 2050: **675 thousands**
Projected Jobs by 2050: **337 thousands**
Expected number of tourists by 2050: **98 thous.**

Growing District
Industrial & Logistics Hub:

An export-oriented industrial center located along key rail and highway corridors. It is slated to host a new international airport.

Key Figures

Total Area: **36 622 hectares**
Industrial Area: **2160 hectares**
Projected Population by 2050: **650 thousands**
Projected Jobs by 2050: **307 thousands**
Expected number of tourists by 2050: **500 hectares.**

Green District
Tourism & Recreation Hub:

The largest district (31,730 hectares), bordering the Kapshagay Reservoir. It is designated for resorts, parks, and leisure, with long-term plans for a Formula 1 track.

Key Figures

Total Area: **31 730 hectares**
Industrial Area: **490 hectares**
Projected Population by 2050: **320 thousands**
Projected Jobs by 2050: **171 thousands**
Expected number of tourists by 2050: **up to 3,5 mln.**

[116] Alatau City official website

Key Partners, **Governance & Investors**

The project is defined by a unique public-private governance model:

Government & Governance:

Alatau City Development Council:
A new strategic body chaired by the Prime Minister, placing the city under the direct control of the Government.

Alatau City Authority (ACA):
A state-backed fund being established to manage implementation, coordinate infrastructure, and promote the city.

International Planners & Consultants:

Surbana Jurong (Singapore):
Developed the foundational master plan.

KPMG Korea:
Engaged to design the industrial zone strategy and attract South Korean anchor investors.

Confirmed Investors & Construction Partners:

Association of Koreans in Kazakhstan:
Initiator and investor for the "K-Park" project.

China State Construction Engineering Corporation (CSCEC):
Signed a tripartite agreement to develop the new business district in the Gate District.

Rhenus Logistics:
In partnership discussions to develop a transport and industrial hub.

PepsiCo & Caspian Group:
Have active projects in the Gate District.

Long-Term **Goals & Projections**[117]

The project has a multi-decade timeline with ambitious demographic and economic targets:

By 2030

Establish the core infrastructure of the Gate and Golden districts, complete the "K-Park," and secure the first wave of anchor tenants for the industrial and business zones.

By 2048 – SEZ Expiry

Have a fully developed, self-sustaining industrial and commercial ecosystem.

By 2050

Population:
1.9 to 2 million residents.

Jobs:
Creation of approximately 1 million new jobs.

Housing:
Over 55 million square meters of housing stock.

Economy:
A diversified, high-tech economy that significantly reduces Almaty's demographic and economic load.

[117] Alatau City official website

The "Alatau" **Special Economic Zone (SEZ)**

The primary financial engine for the project is the "Alatau" SEZ, which covers the city's entire territory. It provides an aggressive incentive package to attract capital[118], including:

0%

Corporate Income Tax
Land Tax
Property Tax
VAT on goods sold within the SEZ
Customs Duties (Free Customs Zone procedure)

Integration with the **AIFC Legal Framework**

a. A Familiar Legal Jurisdiction based on English Common Law

The primary mechanism provided by the Astana International Financial Centre (AIFC) to prospective Alatau City investors is a predictable, internationally recognized legal jurisdiction. The special legislation being drafted for Alatau is expected to incorporate foundational principles of the AIFC, which are derived from the doctrines of English Common Law. For international investors, this provision is significant as it mitigates regulatory and legal uncertainty. This structure allows entities to formulate contracts, structure complex transactions, and manage consortia under a legal framework that functions as a global standard for international commerce, thus reducing the complexities of navigating an unfamiliar domestic legal system.

b. Access to Independent Dispute Resolution

This legal framework is operationally enforced by an autonomous judicial system. By leveraging the AIFC's jurisdiction, entities investing in Alatau projects gain access to the AIFC Court and the International Arbitration Centre (IAC). These bodies are institutionally separate from the domestic judicial system and are presided over by independent, non-affiliated jurists from common law jurisdictions. This architecture guarantees that commercial disputes will be adjudicated impartially, transparently, and in the English language, a critical precondition for securing large-scale foreign direct investment and mitigating political or operational risk.

c. Availability of Advanced Corporate Structures

AIFC provides a sophisticated and flexible corporate registry, offering structuring mechanisms essential for complex, capital-intensive projects. Investors can utilize the AIFC to establish a variety of legal entities, including Special Purpose Vehicles (SPVs), Investment Funds, and Holding Companies, to channel capital into Alatau. For instance, an international consortium could form an AIFC-registered fund, structured as a Limited Partnership, to finance a large-scale real estate development. The AIFC's flexible regulations, which are aligned with global financial centers, facilitate this complex financial engineering, simplifying the management of capital, the allocation of risk, and the attraction of co-investors.

d. Streamlined Registration and Operational Support

Functioning as a "one-stop-shop" registrar, the AIFC apparatus – specifically the AIFC Authority and the Astana Financial Services Authority (AFSA) streamlines the practical business operations associated with incorporation and maintenance. Foreign entities can register an Alatau-focused holding company entirely in English, benefiting from simplified procedures for business incorporation, financial services licensing, and ongoing regulatory compliance. Furthermore, the AIFC's Expat Centre provides a dedicated, simplified process for securing visas and work permits for essential foreign personnel, reducing bureaucratic friction and ensuring that specialist technical and managerial talent can be mobilized efficiently.

[118] Alatau City official website

Financing The Future City: New Models for Urban Investment 5.0

Key findings

Around 65% of municipalities
worldwide rely primarily on city budgets to finance smart-city initiatives

Approximately 10%
of smart city projects worldwide are financed primarily by private investors

Roughly 40% of projects
are implemented through public–private partnerships (PPPs)

Strengthened PPP frameworks can mobilize
≈ USD 488 million
in additional private capital per country

Section Summary:

Global cities are rethinking how to fund digital and sustainable infrastructure. Despite abundant capital, most smart-city projects still rely on public budgets, with few meetings private investors' standards for risk and return. To bridge this gap, cities are turning to hybrid financing models – combining public funds, development finance, and private investment through PPPs, blended finance, and value-capture mechanisms.

Technology firms are emerging as co-investors, embedding funding and expertise into long-term, performance-based contracts that link innovation to measurable outcomes.

Ultimately, the future of smart-city finance depends less on capital availability and more on financial structure – transparent governance, outcome-linked payments, and scalable models that turn public projects into investable assets.

Redefining urban finance: **the current investment landscape**

5.1

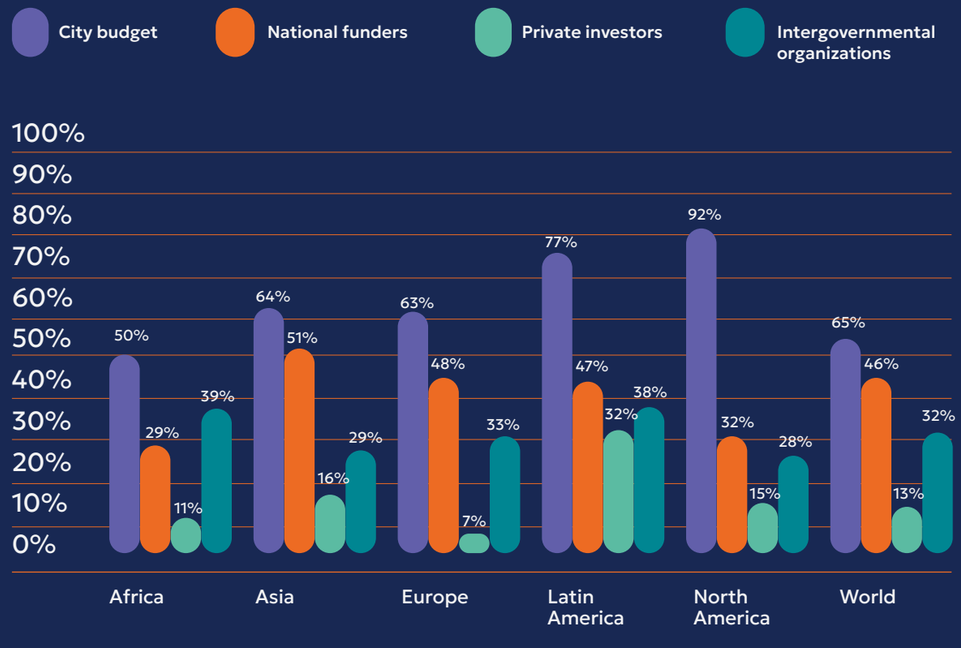
Smart-city growth now depends on how effectively cities convert public investment into self-sustaining value. Financing the infrastructure assets required for this transformation remains a critical challenge, particularly for municipalities that still depend on traditional public funding while facing budget constraints, limited fiscal autonomy, and rising debt levels. Although global capital for infrastructure investment remains abundant, the key barrier is not the supply of finance but the scarcity of bankable, investment-ready projects that meet private-sector risk–return expectations.

Policymakers often evaluate climate-smart and digital-infrastructure projects based on economic viability – considering social, environmental, and productivity benefits such as reduced emissions, avoided health costs, and improved urban livability. By contrast, private and institutional investors assess financial viability, focusing on predictable cash flow, creditworthiness, and returns relative to risk. This asymmetry explains why many economically beneficial smart-city projects remain underfinanced: they are socially valuable but financially unattractive under current market conditions.

Moreover, existing financial markets largely fail to internalize environmental externalities – the long-term economic costs of pollution, congestion, and climate impacts. As a result, urban projects that generate large public benefits (e.g., flood resilience, digital inclusion, or green-space restoration) often lack monetizable revenue streams. This leads to a misalignment between public priorities and private capital flows, reinforcing the need for hybrid financing models.

Figure 29

Percentage of municipalities relying largely on funding from city budgets, national agencies, private investors, and intergovernmental organizations



Source: Beckers et al., 2022 – UN-Habitat Global Review of Smart City Governance
Note: Percentages do not sum to 100 percent because respondents could select multiple significant sources of funding for the same project

Empirical evidence confirms this imbalance. According to a global survey conducted by UN-Habitat for its Global Review of Smart City Governance Practices (Fig. 29)[119], approximately 65 percent of municipalities worldwide rely primarily on city budgets to finance smart-city initiatives, while national funds and international grants account for much of the remainder. Private capital plays only a limited role – identified as a major source by about 13 percent of respondents – though participation rises to roughly one-third among Latin-American cities. The survey, which gathered responses from nearly 300 officials across more than 250 municipalities in Africa, Asia, Europe, Latin America, and North America, underscores the predominance of public funding and the uneven contribution of private finance globally.

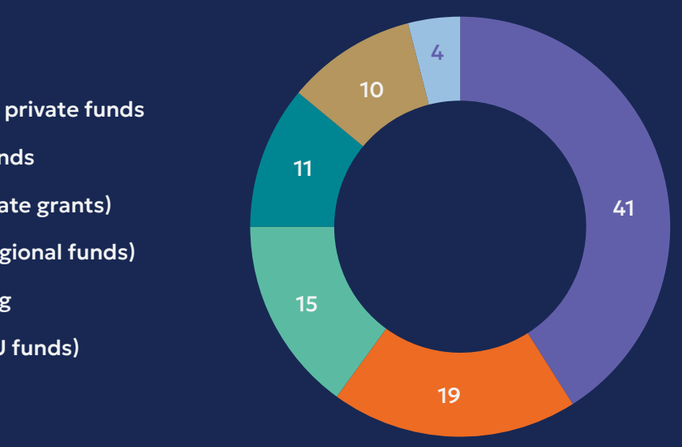
Complementary estimates from Deloitte (Fig. 30)[120] show that only 10 percent of smart-city projects are financed entirely by private investors, while about 40 percent operate through public–private partnerships (PPPs). The remainder depend largely on government or donor resources, reflecting the limited maturity of local capital markets and weak municipal revenue systems. Key obstacles include fragmented governance, immature revenue systems, and difficulty monetizing benefits like time savings or emission cuts.

Even where projects are technically feasible and economically justified, many remain underfunded, delayed, or downsized due to the lack of credible risk-sharing arrangements and sustainable revenue models. This persistent financing gap – between the scale of urban ambition and the structure of existing funding instruments – remains one of the principal obstacles to implementing smart-city strategies worldwide. Addressing this gap will require rethinking how urban projects are prepared, governed, and evaluated for investment readiness.

Figure 30

Funding and Financing options typically chosen by smart cities (%)

Source: Deloitte (2018), The Challenge of Paying for Smart Cities Projects



[119] Beckers, D., Gerli, P., Mora, L., Thabit, S., & Tonnarelli, F. (2022). Global Review of Smart City Governance Practices.

[120] Deloitte (2018), The Challenge of Paying for Smart Cities Projects

Astana International Financial Centre

Catalyzing private capital: innovative financing mechanisms

5.2

From blended finance and PPPs to green and impact-linked bonds, new instruments are transforming how cities fund sustainable infrastructure

With conventional municipal budgets stretched and national transfers insufficient to meet rising infrastructure demand, cities are increasingly experimenting with new financing architectures that combine public resources, development finance, and private capital. These emerging mechanisms are less about replacing public funding than about restructuring financial risk and broadening participation in urban investment.

The Shift Toward Hybrid Models

Across global practice, public–private partnerships (PPPs) remain the dominant model for scaling smart-city infrastructure. When structured transparently, PPPs allow cities to shift upfront capital costs to private partners in exchange for performance-based payments over time. Governments typically retain strategic control, while private entities provide finance, technology, and operational expertise. The World Bank (2024)121 found a strong correlation between well-designed PPP frameworks and higher levels of private infrastructure investment: even modest improvements in PPP governance can unlock an average of USD 488 million in additional private capital per country.[117] Their success, however, depends on credible legal frameworks, predictable revenue streams, and fair risk-allocation mechanisms that align public and private incentives.

Beyond PPPs, blended-finance models are gaining momentum as cities seek to make projects investment-ready. Development finance institutions (DFIs) and multilateral banks – such as the IFC, EIB, and ADB – deploy concessional loans, first-loss guarantees, and project-preparation facilities to de-risk investments and crowd in commercial capital. These approaches are especially effective for projects with social or environmental benefits – for example, energy-efficient housing, low-carbon transport, or digital inclusion – where returns extend beyond purely financial metrics.

A related frontier involves value-capture finance, which monetizes the economic uplift generated by public investment. Instruments such as tax-increment financing, land-value premiums, or developer contributions enable cities to recycle part of the increased property value into further infrastructure upgrades. East Asian and European cities have demonstrated that capturing even a small portion of land-value appreciation can significantly offset public expenditure on transport and digital infrastructure. Extending these approaches to data-driven services – where improved connectivity enhances business productivity – offers an untapped source of urban revenue.

Evolving Business Models and the Role of Technology Partners

Cities that successfully mobilize private capital increasingly structure projects around viable, revenue-generating business models, reducing reliance on subsidies while ensuring long-term sustainability. Typical approaches include subscription-based services, data-sharing agreements, and performance-linked contracts that tie investors to measurable impacts such as energy savings or emissions reduction.

To enhance return on investment (ROI), many cities are adopting metered or pay-per-use systems, where service fees are tied to actual consumption, or pay-for-performance (P4P) mechanisms, in which payments depend on meeting predefined service-quality or availability targets. Others experiment with advertising-financed services, developed in partnership with tourism boards, media firms, and marketing agencies. For example, New York's LinkNYC offers free high-speed Wi-Fi through kiosks financed entirely by digital advertising, while Seoul has partnered with private media firms to support real-time information panels across transport hubs.

At the innovation frontier, Public Procurement of Innovation (PPI) is emerging as a powerful catalyst for co-developing new solutions. Under this model, municipalities partner with startups, universities, and technology providers to co-finance and pilot "lighthouse" projects – from Helsinki's Mobility-as-a-Service (MaaS) trials to Amsterdam's circular construction pilots. These collaborations help cities accelerate technology adoption while giving private partners a living testbed to refine and scale commercially viable solutions – transforming urban innovation into a global export opportunity.

[121] World Bank. Benchmarking Infrastructure Development: PPP Regulatory Landscape - Assessing Quality and Exploring Reform. Washington, DC: World Bank, 2024

Technology Firms as Strategic Investors

Global technology conglomerates have fundamentally transitioned from their legacy role as equipment providers to serve as pivotal strategic partners in smart-city financing. This evolution is characterized by their active participation in Public-Private Partnerships (PPPs), where they now engage in direct co-investment for the deployment of both physical infrastructure and advanced digital platforms.

This trend is exemplified by the flagship initiatives of major market leaders:

Launched in 2015, Cisco's Country Digital Acceleration (CDA) programme now operates in more than 50 countries and has supported over 1,600 projects advancing national digital transformation.[122] Its portfolio includes smart-transport initiatives in Singapore, city-wide Wi-Fi infrastructure in Barcelona, and data-platform development in Dubai – illustrating how strategic technology partnerships can accelerate urban innovation and connectivity.

Microsoft is advancing urban transformation through its cloud, AI, and IoT-enabled smart-city ecosystem. It supports platforms in cities such as Năvodari (Romania), Taoyuan (Taiwan), and Kelowna (Canada) to enhance citizen services using hybrid cloud and generative AI. In Qatar, the Azure-based TASMU platform plans over 200 digital solutions within the next decade, showcasing how scalable and interoperable infrastructure can drive smarter, more sustainable urban systems.

Huawei's Smart City Solutions program supports over 200 projects globally, often using its Intelligent Operation Center (IOC).[123] These projects deploy integrated command centers, 5G, and IoT for public safety, utilities, and energy management. Key examples include Shenzhen's command system and contributions to energy networks in Dubai and Riyadh, typically delivered via local partnerships.

AWS's Smart City Competency Program offers municipalities cloud-based infrastructure, data analytics, and AI tools for smarter service delivery. The company supports urban data platforms and predictive analytics in cities such as Los Angeles, Jakarta, and Dubai, focusing on traffic management, resource efficiency, and emergency response. In partnership with civic agencies, AWS provides grants and technical expertise to scale digital public services securely and cost-effectively.

While these collaborations help cities access capital and technical expertise, experts emphasise the importance of data sovereignty, open standards, and long-term governance safeguards to ensure that digital infrastructure serves public-interest objectives rather than proprietary ecosystems.

[122] Cisco Country

[123] Smart City-Huawei

Understanding the Urban-Finance Ecosystem

Smart-city funding relies on complex interactions among public institutions, private investors, and end-users. As shown below, sustainable urban development requires coordination between municipal budgets, national transfers, concessional finance, and private-sector instruments. Recognising this ecosystem helps policymakers design blended models that balance fiscal responsibility with market participation

Figure 31

Sources of Finance in Municipalities and Interplay Between Public and Private Stakeholders

Source: Adapted from the Global Green Growth Institute (GGGI) and European Environment Agency (2023)

The Rise of Thematic and Impact-Linked Bonds

Alongside traditional debt, green, social, and sustainability-linked bonds are opening new channels for institutional investors seeking measurable impact. These instruments allow municipalities to finance climate-resilient transport, renewable-energy grids, and smart-water systems while meeting international ESG benchmarks. Digital-infrastructure bonds and impact-linked loans go further – linking interest rates to verified outcomes such as energy savings, service efficiency, or expanded digital access.

International coordination further strengthens the project pipeline. Programs such as Japan's Vision for a Digital Garden City Nation[124] and the European Union's Smart Cities Marketplace[125] demonstrate how pooling projects, sharing data, and standardising risk metrics can reduce transaction costs and accelerate private participation. Both models emphasise multi-level, long-term funding ecosystems rather than fragmented, short-term grant cycles.

Such an approach offers valuable lessons for Kazakhstan, where a coordinated national–municipal financing model could help unlock private capital for smart-city initiatives. By adapting these frameworks to local realities – linking national programs like Digital Kazakhstan with city-level projects in Astana, Almaty, and Shymkent – the country can bridge current investment gaps and accelerate digital infrastructure rollout. Applying pooled-capital and PPP-based mechanisms would also enable smaller cities and regional centers to participate in innovation, ensuring that Kazakhstan's smart-city transition remains both financially sustainable and geographically inclusive

Implementation Challenges

Despite momentum, many cities continue to face fragmented oversight, regulatory uncertainty, and limited technical capacity to manage complex instruments. Institutional investors also cite weak data transparency and the absence of consistent ESG reporting as barriers to entry. Development banks and financial centers thus play a crucial enabling role – not only as funders but as market conveners, building creditworthiness, harmonizing standards, and translating public-policy objectives into investable portfolios.

[124] The Government of Japan

[125] Smart Cities Markerplace

Astana International Financial Centre

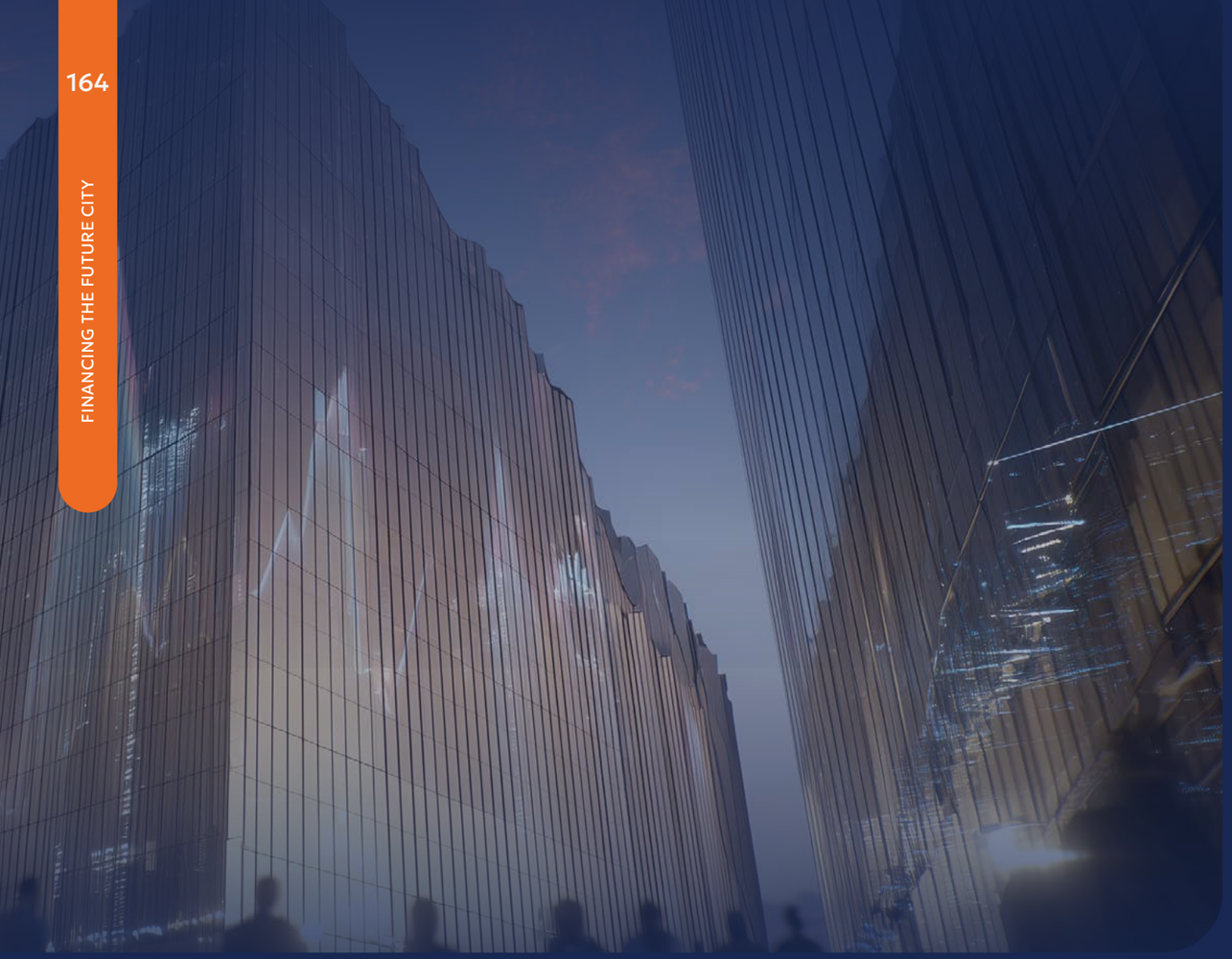
Connecting Markets and Cities: **The Role Of Capital Hubs**

5.3

Financial centers and development institutions are becoming catalysts for sustainable urban investment – linking local projects with global sources of capital.

The transition to sustainable and digitally enabled cities depends increasingly on how effectively urban infrastructure connects to global financial markets. While national governments and municipalities remain the primary funders of city infrastructure, their resources alone are insufficient to meet the scale of investment required.

Capital markets and financial hubs now play a pivotal role in mobilizing institutional finance, pooling risk, and standardizing investment frameworks for smart-city projects.



Capital Markets as Urban Enablers

Capital markets convert fragmented, short-term public expenditures into long-term, investable asset classes. Through instruments such as municipal bonds, infrastructure investment trusts (InvITs), and securitized loan portfolios, cities can attract participation from pension funds, insurers, and sovereign wealth funds seeking stable returns and ESG-compliant assets. The emergence of green, social, and sustainability-linked bonds has further aligned urban infrastructure with climate and impact-investment objectives.

However, only a limited number of municipalities – mainly in high-income countries – possess the technical and regulatory capacity to issue such instruments. For most developing economies, financial hubs and multilateral development banks serve as intermediaries: they aggregate projects, and ensure alignment with international disclosure and governance standards such as the ICMA Green Bond Principles, OECD Blended Finance Guidance, and UN SDG taxonomy.

This intermediation function is critical for translating national and city-level priorities into portfolios that meet institutional investors' expectations for scale, transparency, and risk diversification.

Development Partners and Global Financing Initiatives

Multilateral institutions play a crucial role in helping cities bridge their financing gaps.

The World Bank's Global Smart City Partnership (GSCP) offers technical assistance, project preparation and in grant funding to strengthen digital governance and integrated urban planning

The Asian Development Bank's Smart City Pathways for Developing Asia provides loans ranging from USD 50 million to USD 200 million and technical support for pilot projects in ICT, clean transport, and energy efficiency[126]

Similarly, the UNDP Smart Cities Programme and its City Experiment Fund[127] provide grants and mentorship for innovative pilots in areas such as digital identity, sustainable urban hubs, and civic-technology platforms

At the same time, the European Bank for Reconstruction and Development (EBRD) continue to scale its Green Cities Program, which combines loans and grants to finance low-carbon mobility, water management, and energy-transition infrastructure.

Together, these mechanisms illustrate the growing pool of concessional and blended finance available for cities seeking to advance digital transformation and sustainability. Yet to fully leverage these resources, cities coordinate through financial intermediaries and capital hubs that can standardize procedures, ensure compliance with global frameworks, and crowd in private investors.

Emerging Role of Regional Financial Hubs

Across the world, specialized financial centers are emerging as pivotal intermediaries between cities and global capital flows, enabling sustainable and digital infrastructure projects to attract institutional investment. These hubs operate at the intersection of policy, finance, and technology, helping translate local development priorities into investable portfolios that meet international standards of transparency, risk management, and sustainability.

[126] ADB Signs $50 Million Commitment to Accelerate Energy Transition in Asia and the Pacific

[127] About City Experiment Fund

Global Models of Urban Financing Hubs

Singapore

– Infrastructure Asia serves as a regional platform linking Southeast Asian governments with investors and technical partners for sustainable infrastructure. It aggregates city-level projects, provides bankability assessments, and facilitates blended-finance structures with multilateral banks and private capital.

Dubai

International Financial Centre (DIFC) has positioned itself as a regional conduit for ESG and green-finance innovation, hosting dedicated frameworks for green sukuk, sustainability-linked loans, and fintech-enabled infrastructure finance across the Middle East and Africa.

London's

Green Finance Institute (GFI) operates as a bridge between public policy and private capital, developing standardized green-investment frameworks for urban retrofitting, clean mobility, and local energy transition projects in the United Kingdom and beyond.

AIFC,

through its Green Finance Centre, is positioning Kazakhstan as Central Asia's sustainable-finance hub. The GFC develops ESG markets, provides second-party opinions under the national Green Taxonomy, and has verified over 70% of Kazakhstan's green bonds and loans. As the only Climate Bonds Initiative-accredited reviewer in the region and Secretariat of the Turkic Green Finance Council, the AIFC connects global investors with scalable, standards-based financing for smart-city and green-infrastructure projects across Eurasia.

Functions and Instruments

Regional financial hubs play three key roles in accelerating sustainable urban investment:

Aggregation and Standardization

They consolidate smaller municipal and infrastructure projects into investable portfolios, applying global frameworks such as the ICMA Green Bond Principles and OECD Blended-Finance Guidance.

Risk Mitigation and Credit Enhancement

Through partnerships with development banks and export-credit agencies, hubs structure guarantees, subordinated tranches, and insurance mechanisms that lower perceived risk for institutional investors.

ESG and Disclosure Alignment

They promote environmental and social taxonomies, verification systems, and transparent reporting standards that build investor confidence and expand the supply of bankable projects.

Strategic Relevance for Emerging Economies

For developing and middle-income countries, these hubs are not only financial marketplaces but knowledge and capacity platforms. They help cities improve project preparation, adopt global accounting and disclosure practices, and access blended capital from multilateral, sovereign, and private sources. In doing so, regional hubs convert fragmented public budgets into scalable, investment-grade portfolios – bridging the persistent gap between urban ambition and financial feasibility.

The Next Wave Of Urban Development: **Investing In Smart City Infrastructure And Technology**

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