

Green Smart City Transformation Driven by Innovation and Citizen Participation

Region	Europe and Central Asia
Award Scheme	Shanghai Manual
Themes	Data-Driven Process and Management Environmental Resilience Innovation Local Govts & decentralization Social Inclusion Urban Governance and Legal Frameworks Waste Management
Sustainable Development Goals	Goal 9 - Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation Goal 11 - Make cities and human settlements inclusive, safe, resilient and sustainable Goal 13 - Take urgent action to combat climate change and its impacts

Summary

Barcelona’s smart city transformation represents a pioneering model of technology-driven yet human-centred urban governance. Facing challenges of density, inequality and fragmented management, the city redefined its development trajectory through innovation, sustainability and citizen participation. Its evolution spans three phases: technological experimentation, data-driven governance and citizen co-management. In its early phase, the creation of the Barcelona Supercomputing Centre (BSC) enabled advanced urban simulations and digital infrastructure management. During the data-driven phase, the city launched the Sentilo platform, integrating 19,000 sensors to monitor traffic, energy and air quality. Since 2015, the citizen co-governance phase has seen projects like Decidim, an open-source platform that empowers residents to shape policies, and Cuidem Barcelona, which improved waste management through community participation. These initiatives have improved efficiency, environmental performance and public trust, making Barcelona one of the world’s top three smart cities. Its governance model combines open data, ethical technology and digital democracy, ensuring inclusivity and transparency. By aligning innovation with sustainability and social equity, Barcelona exemplifies how cities can balance technology and human values to achieve resilience, participation and green urban growth — a benchmark for global cities seeking sustainable, people-oriented transformation.

Background and Objective

Barcelona, a historic and high-density city, has long been an economic and cultural hub of Spain and Europe. However, by the early 21st century, it faced complex urban challenges — overcrowding, aging infrastructure, fragmented governance and unequal access to services. To overcome these issues, the city redefined its development trajectory through a smart, sustainable and citizen-driven approach. Since 2011, under its Smart City Strategy, Barcelona has combined digital innovation with participatory governance to

enhance quality of life, reduce emissions and improve efficiency. The city's long-term commitment to sustainable urbanism and technology has positioned it as a global leader and the first historic European city centre to achieve smart city certification. Barcelona's strategy aims to integrate digital technology into urban systems while prioritizing people, sustainability and social inclusion. Its goals include improving service delivery through data-driven governance, advancing energy efficiency, supporting digital innovation for SMEs, and fostering civic participation in decision-making. The city seeks to balance technological progress with democratic engagement, ensuring that digital transformation serves citizens equitably while contributing to climate action and economic resilience.

Actions and Implementation

Barcelona's smart city development evolved through three stages: technological experimentation, data-driven management and citizen co-governance. Early efforts focused on solar energy policies, electric mobility and the creation of the Barcelona Supercomputing Centre (BSC), which enabled real-time environmental modelling and emergency simulations. From 2011, the city implemented its ICT strategy and launched the Sentilo sensor platform integrating 19,000 sensors to monitor mobility, energy and air quality. Later, under the Barcelona Digital City Plan (2015–2019), participatory tools like Decidim empowered citizens to influence policy decisions directly. The city also implemented projects such as SCOREwater for wastewater management and Cuidem Barcelona, a co-managed platform for waste collection and public space maintenance.

Outcomes and Impacts

Barcelona's integrated approach has significantly improved urban efficiency and sustainability. Real-time data systems reduced energy use, optimized irrigation and decreased traffic congestion. The Decidim platform fostered transparency and public trust, influencing hundreds of civic initiatives adopted by the city council. SCOREwater enhanced environmental management through advanced sensor networks, while Cuidem Barcelona increased waste collection efficiency by 40 per cent and reduced related complaints by 23 per cent. These achievements have placed Barcelona among the top three smart cities globally, according to international rankings.

Sustainability and Scalability

Barcelona's model is underpinned by institutional innovation, long-term planning and multi-stakeholder collaboration. By establishing frameworks for data ethics, open-source platforms and public-private cooperation, the city ensures both sustainability and replicability. Its initiatives, such as the Digital Twin collaboration between BSC and the Municipal Institute of Information Technology, exemplify how evidence-based decision-making can be scaled to other cities. Continuous updates to green infrastructure

and digital policies further ensure environmental, social and economic sustainability.

Gender and Social Inclusivity

Citizen inclusion and equality form the foundation of Barcelona's smart city governance. Platforms like Decidim ensure that women, youth and marginalized groups have equal opportunities to shape policies. Digital literacy initiatives enhance accessibility, while community-level projects like Cuidem Barcelona foster collective responsibility. By embedding inclusivity into digital design, the city ensures technology supports empowerment and equity rather than deepening divides.

Innovative Initiative

Barcelona's innovation lies in its synthesis of technology, governance and civic participation. The integration of IoT, AI and open-source digital infrastructure with participatory mechanisms like Decidim transforms the city into a living laboratory for co-governance. The BSC's high-performance computing capabilities underpin advanced applications such as climate modelling and digital twin simulations, setting new standards for evidence-based urban management.

Resources devoted to delivery

The city's initiatives are financed through a mix of municipal funding, European Union programmes and partnerships with academic and private institutions. Key resources include the BSC, the Sentilo data infrastructure, and multi-stakeholder collaborations with the European DECODE project and local innovation hubs. Human and technical capacity are continually enhanced through training, research and open innovation ecosystems.

Conclusion

The initiative demonstrates that smart city transformation is most effective when driven by technology that serves people. Its combination of digital innovation, participatory governance and sustainability positions it as a model for cities seeking to achieve inclusive, resilient and green urban futures. Through continuous adaptation, ethical digital governance and civic empowerment, Barcelona offers a replicable and human-centred pathway for the next generation of smart cities.