

Long-Term Strategy for Smart Cities Governance Projects across Europe

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In the context of our rapidly evolving world, where pressing issues like anthropogenic climate change and accelerating urbanization demand innovative solutions, a critical evaluation of the potential and impact of digital technologies is necessary. Climate-neutral governance entails the implementation of governmental instruments and tools designed and used to harmonize short-term policy actions with a long-term vision of achieving a climate-neutral state. This fact aims to facilitate evidence-based decision-making, foster inter-sectoral coordination, enhance transparency, and cultivate public legitimacy for climate mitigation and adaptation measures. This paper presents a focused analysis of SmartCities projects and their implementation across diverse urban centers and nations. Our objective is to provide a comprehensive overview, highlighting recent advancements in the realm of smart and climate-neutral city governance. Furthermore, we conduct a comprehensive inquiry into Romania's legislative framework, encompassing the regulations and strategies pertaining to energy, climate change, and urban development. This analysis is complemented by an exploration of the evolving perspectives and legislative proposals that are likely to shape the future course of action in these domains.

Keywords: Smart Cities, Governance, Digital Twin, Long Term Strategy (LTS), Europe LTS, Romania LTS

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1 Introduction

In recent decades, the development of technology has catalyzed the transformation of cities around the world into what is now known as "smart cities". These digitally integrated cities are designed to provide a more efficient, sustainable, and connected urban environment, using technology to improve the quality of life for their residents [1]. However, the success of implementing a smart infrastructure is not only determined by technological advances but also by how these smart cities are managed and governed.

The concept of "smart city governance" refers to the structures, processes, and policies that govern the development and management of smart cities [2]. It is a vast and complex field involving a wide range of aspects, from political decision-making to technical, economic, and social aspects. In this introduction, we will explore the concept of smart city governance, highlighting its importance in the context of global

urbanization and identifying the main issues and challenges [3].

Cities are the engines of economic and social growth in the contemporary world. With more than half of the world's population already living in urban environments, this percentage is expected to continue to rise in the coming decades. Faced with challenges such as climate change, migration, urban congestion, and increasing demand for resources, cities face increasing pressure to become more efficient and sustainable.

Smart cities use technology and data to improve the management and delivery of urban services. These may include solutions such as smart transport networks, efficient management of energy resources, surveillance and security systems, or digital platforms for citizen participation [4]. The goal is to create more connected, efficient, and sustainable cities.

Proper governance is critical to the success and sustainability of smart cities. Smart cities

often involve collaboration between multiple stakeholders, including local governments, the private sector, academia, and civil society. Effective governance can ensure the alignment of the interests and objectives of these parties, as well as transparency and accountability in the decision-making process.

Despite their promise, smart cities also face some challenges. These include data security and privacy concerns, digital and social inequalities, and the risks of over-reliance on technology. However, smart city governance also offers unique opportunities for innovation, economic growth and improved quality of life.

2 Projects for Smart Cities

We analyze some projects implemented on Horizon2020 or other calls in the period 2005-2024.

Projects funded under Horizon 2020 for smart cities are fundamental to promoting innovation and sustainable development of cities in Europe and beyond. These projects represent a joint effort of the scientific community, the private sector, non-governmental organizations, and public authorities to address major urban challenges such as urban mobility, energy efficiency, air quality, resource management and social inclusion. In what follows, we will explore the various aspects of the Horizon 2020 smart cities projects and their impact on the urban future.

Table 1. Project analysis on SmartCities

Project name	Start Year	End Year	Involved countries	Involved Cities	Fuding Programme
TRIBE	2015	2018	Spain	Zaragoza	H2020
			Turkey	Istanbul	
SMARTER TOGETHER	2016	2021	Bulgaria	Sofia	H2020
			Austria	VIENNA	
			France	Lyon	
			Germany	MÜNCHEN	
			Italy	Venezia	
			Japan	Yokohama	
			Spain	Santiago de Compostela	
		Ukraine	Kiev		
SmartEnCity	2016	2021	Bulgaria	Asenovgrad	H2020
			Denmark	SONDERBORG	
			Estonia	TARTU	
			Spain	VITORIA-GASTEIZ	
			Italy	Lecce	
OrbEEt	2015	2018	Austria	INNSBRUCK	H2020
			Spain	ASPARRENA	
			Bulgaria	PERNIK	
			Germany	ERLANGEN	
GreenPlay	2015	2018	Spain	VIGO	H2020
			France	ISÈRE	
...

Horizon 2020, the European Union's largest research and innovation program, had an ambitious agenda to fund projects to tackle Europe's social, economic, and environmental challenges. Within the program, special attention was paid to the development of smart cities, given that around 70% of the European population lives in urban areas and that cities are the centers of innovation and economic growth.

By implementing smart technologies and innovative solutions, the projects aim to improve the quality of life of urban residents by providing more efficient services, access to public transport and green spaces, and reducing pollution [5].

Projects funded under the Horizon 2020 program for smart cities have a significant

impact on the urban future. They demonstrate that technology can be a powerful tool to address major urban challenges and create smarter, more sustainable, and more inclusive cities.

Through cross-stakeholder collaboration and the application of innovative and integrated solutions, Horizon 2020 smart cities projects pave the way for a better and more sustainable urban future.

For each project, the starting year of the project, the year of completion, the countries involved in the project as well as the cities where the prototype was made were identified [6]. Table 1 shows some examples of indexed projects. Similarly, 40 projects were analyzed. The 40 projects identified and analyzed were carried out in 42 countries and 297 cities, Figure 1.



Fig. 1. Countries that implement projects for SmartCity

It can be seen in Figure 1 that in certain countries there were more projects and more cities involved in projects developed for SmartCity, such as Spain where 42 cities are involved. And from Italy there are 39 cities

involved. From Romania, 9 cities were involved in these projects.

3 EU and Romania's Long-Term Strategy

The European Union is leading the global energy transition by meeting the goals set out in the Paris Agreement on climate change, which aims to deliver clean energy across the European Union.

To meet this commitment, the European Union has set energy and climate targets for 2030.

The transition to climate neutrality will bring significant opportunities, such as the potential for economic growth for new business models and markets, new jobs, and technological developments. Forward-looking research, development, and innovation (RDI) policies will play an important role.

However, achieving climate neutrality will require overcoming serious challenges and will require appropriate tools, incentives, support, and investment to ensure a cost-effective transition, equity, balance and social equity, taking into account different circumstances. The transition will require significant public and private investment.

The EU aims to be climate neutral by 2050 – an economy with net zero greenhouse gas emissions. This objective is at the heart of the European Green Deal and is in line with the EU's commitment to global action on climate change under the Paris Agreement [7]. The transition to a climate-neutral society is both an urgent challenge and an opportunity to build a better future.

All parts of society and economic sectors will play a role – from the energy sector to industry, mobility, buildings, agriculture, and forestry. The EU can lead the way by investing in realistic technology solutions, empowering citizens, and aligning action in key areas such as industrial policy, finance, and research, while ensuring social equity for a just transition.

The approval of the climate neutrality objective was the result of an extensive debate, carried out at the institutional level and in society, based on the long-term strategic vision presented by the European Commission (EC). This included a detailed analysis of possible solutions for making the transition to a climate-neutral economy. In

accordance with the provisions of the Paris Agreement, through a deep commitment to an ambitious social and economic transformation, both the EU and the member states, including Romania, can provide a global example in the fight against climate change, showing that the path to climate neutrality it is not only an imperative necessity but also an achievable and desired goal. The Member States' Long-Term Strategy must reflect the need to step up collective ambition and provide essential long-term policy guidance to limit the impact of climate change. The preparation for the development of the National Long-Term Strategy for the reduction of greenhouse gas emissions (GHG) is based on EU Regulation 2018/1999. This Regulation, in Article 15, requires each Member State to explain how it intends to contribute to the achievement of the objectives set out in the Paris Agreement. The LTS must outline the way in which the member state will participate in the achievement of European long-term objectives, thus facilitating the fastest possible achievement of climate neutrality within the EU and the implementation of an efficient energy system, predominantly based on renewable sources.

The Commission provides support to Member States in the preparation of National Transition Strategies (NTSs), providing information on the scientific basis and possibilities to exchange knowledge and best practices. The Commission can also provide, if necessary, guidelines for the Member States. The Commission carries out assessments to determine whether national LTSs are adequate to achieve the objectives set collectively by the EU under the governance regulation and provides information on any existing collective discrepancies.

4 Data Governance in Smart Cities

Data governance plays a key role in smart city projects, as the collection, storage and use of data are fundamental to the efficient operation of smart infrastructure and services [8]. In the context of smart cities, data is generated by a

variety of sources, such as sensors, IoT devices, monitoring systems and other technologies, and is used to make informed decisions, improve urban services and enhance the quality of life of residents. In what follows, we will explore the importance and role of data governance in smart city projects, as well as the main issues and challenges associated with it.

Smart cities depend on accurate and reliable data to make informed decisions. Data governance ensures that the data collected is of high quality, consistent and relevant to the city's needs and objectives.

Data collected in smart cities can include sensitive information about residents, such as location data, health data or financial information. Data governance requires strict security and privacy measures to protect this information from unauthorized access and misuse [9].

Data governance includes establishing clear policies and procedures on data collection, storage, and use, promoting transparency and accountability in urban data management.

In a complex urban environment, data is often collected and used by multiple departments and organizations. Data governance promotes interoperability and data exchange between various systems and platforms, facilitating the efficient use of data in all urban domains.

Developing a legal and regulatory framework to govern the collection, storage, and use of data in smart cities. These policies should address issues such as data privacy, cyber security, and data access.

Implementing data management practices and technologies to ensure efficient collection, storage, and management of urban data. This may include the use of centralized databases, data management systems and data analysis tools [10].

Raising awareness and education about the importance of data governance among public authorities, private organizations, and citizens to promote responsible and ethical use of urban data.

"Digital Twins" technology can be used in the design of smart cities to streamline various processes such as traffic, electricity

consumption and others. The digital twin can be used to make simulations to help city leaders make governance decisions. In [11] a smart city governance model based on "Digital Twin" technology is proposed. By developing and implementing a "Digital Twin" of the city, its smart operation can be established (Smart City Operation Office) and city officials will manage its problems (govern) within a Smart City Operation Center (Smart City Operation Center smart city operation) and will appoint a Chief Operating Officer (Chief Operating Officer) to take charge. The city's smart operation center was under the jurisdiction of the operations officer. The city's intelligent operation center manages four major sectors for urban information including the Urban IT Operation and Maintenance Center, the "Big Data" Center, the Urban Operations Monitoring and Command Center and the Intelligent Service Center (including "open" platforms -data" databases and other companies) [12]. The main functions of the smart city operation office include:

- Participation and review of the high-level concept of the city;
- Planning and reviewing the general objectives, framework of tasks, operating mechanisms, and development management of computerization in various industries;
- Development of relevant policies, regulations, and standards;
- Responsibility for the integration and sharing of urban information resources;
- City operations monitoring, interdepartmental coordination, and command;
- Promoting the formation of the system of "open-data" socially oriented applications, services, and transactions.

The description of this governance model can be seen in the block diagram in Figure 2. Existing Implementations Digital Twins technology for smart cities is still new but most cities are expected to implement a digital twin by 2030. According to Pramotedham CEO of Esri Singapore "only with a digital twin at their disposal can government

agencies effectively analyze what can be done with available data and improve the lives of citizens, create economic opportunities and revitalize a more closely connected

community." Cities are using "Digital Twins" models to improve efficient urban planning, energy infrastructure and public service delivery.

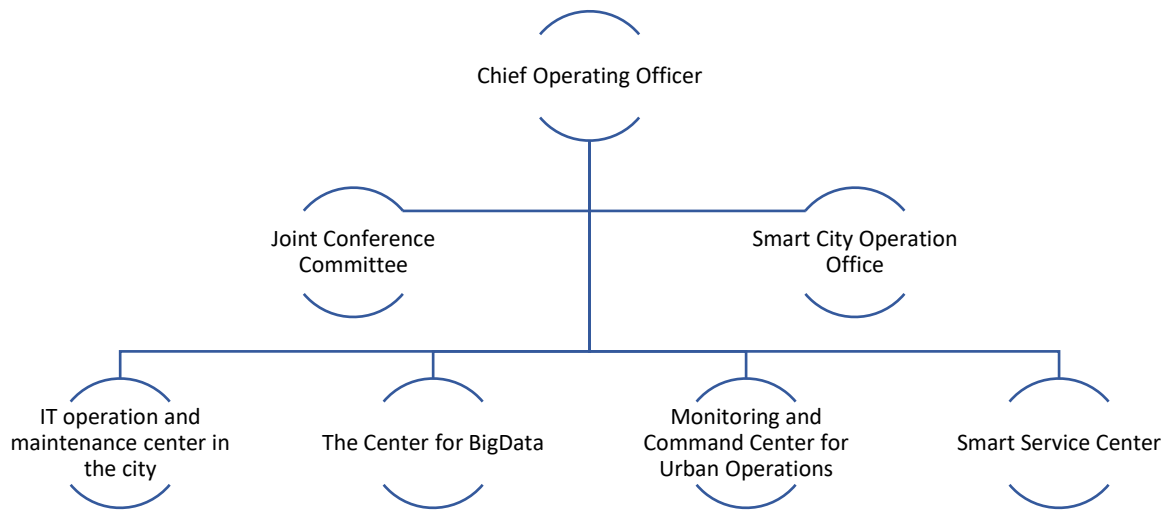


Fig. 2. Example of Governance model for Smart Cities

While data governance is critical to the success of smart cities, it also comes with some challenges. These include managing large volumes of data, ensuring compliance with data protection regulations, managing cyber security risks and promoting a responsible and ethical data culture. Going forward, it is crucial to continue efforts to develop data governance policies and practices that meet the needs and challenges of smart cities and promote the efficient and responsible use of urban data for the benefit of all residents.

5 NetZeroCities - Pilot Cities

NetZeroCities is part of the Horizon 2020 Research and Innovation Programme in support of European Union's Green Deal. NetZeroCities has been designed to help cities overcome the current structural, institutional and cultural barriers they face in order to achieve climate neutrality by 2030 [13].

NetZeroCities supports the EU's Mission of "100 Climate-Neutral and Smart Cities by 2030" newly launched as part of the Horizon Europe program. The project works as a service-oriented platform supported by world-

class practitioners. It helps European cities by providing them with the support and solutions they need to achieve their Net Zero goal in a socially inclusive way.

The first group of 53 pilot cities, from 21 countries in the European Union and the countries associated with the Horizon 2020 program, was selected in 2022, following the first call organized within the NetZeroCities - Pilot Cities Program. Only the cities included in the EU Mission 100 Climate-Neutral and Smart Cities by 2030 were eligible to participate. The call had a budget between 12-20 million Euros. The 53 cities are among 25 winning applications, selected from 103 submitted applications, which involved a total of 159 cities from 33 eligible countries (<https://netzerocities.eu/pilot-cities-cohort-1-2022/>).

Over a period of 2 years, the pilot cities will test and implement innovative solutions, or clusters of solutions, at the city or district level, highlighting lessons learned from the innovation effort, knowledge, capacities and capabilities developed at the city level. At the end of the project, a set of innovative solutions will be available to be implemented, scaled

and/or replicated. These could include new business models, policy initiatives, governance innovation, funding or funding models, replication or scaling strategies.

During the project, NetZeroCities pilot cities receive funding and practical support from specialist consultants and NZC Consortium partners to refine their pilot activities before starting implementation. In addition, the NetZeroCities Mission Platform will help them find funding for full implementation and further replication and scale-up efforts.

In parallel with the Pilot Cities Program, the Twinning Program is being carried out, addressed to cities that are not part of those included in the 100 Climate-Neutral and Smart Cities Mission. The objective is to enable the exchange of knowledge and the transfer of good practices, to support the twin cities in their effort to learn and replicate the experience of the pilot cities, with a practical focus on the replication of systemic transformation methodologies and innovative

approaches demonstrated by the pilot activities, in the evolution towards climate neutrality.

A first call of this program was completed in September 2023, and the next group of twin cities will be selected in spring 2024.

Returning to the first group of pilot cities, out of the 25 winning applications, 6 are multi-city applications, submitted by consortia of cities from the following countries:

- Germany: Aachen, Mannheim, Muenster;
- Italy: Bologna, Bergamo, Florența, Milano, Padova, Parma, Prato, Roma, Torino;
- Poland: Cracovia, Lodz, Rzeszow, Varșovia, Wrocław;
- Slovenia: Kranj, Ljubljana, Velenje;
- Spain: Barcelona, Madrid, Sevilla, Valencia, Valladolid, Vitoria-Gasteiz, Zaragoza;
- Netherlands: Amsterdam, Eindhoven, Groningen, Helmond, Rotterdam, Haga, Utrecht.

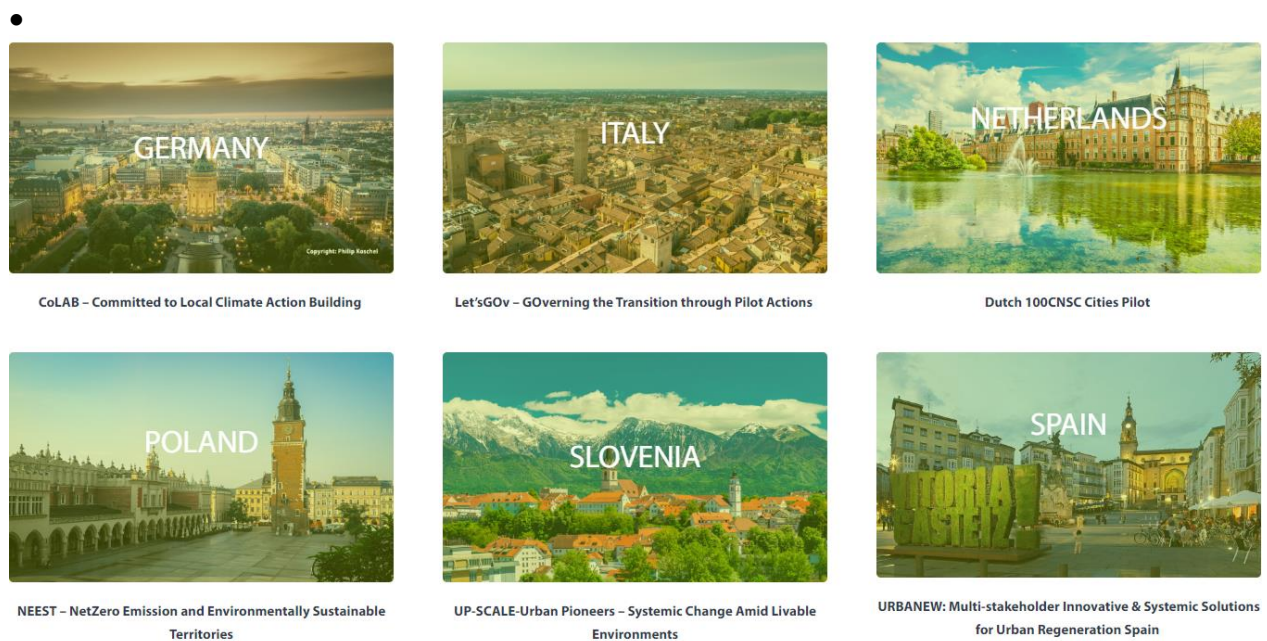


Fig. 3. Multi-City Pilot – Cohort 1

The other 19 winning applications are Individual Pilot Cities: Bristol, UK; Budapest, Hungary; Cluj-Napoca, Romania; Dijon, France; Drammen, Norway; Galway, Ireland; Guimarães, Portugal; Istanbul, Turkey;

Kozani, Greece; Lahti, Finland; Leuven, Belgium; Liberec, Czech Republic; Limassol, Cyprus; Malmö, Sweden; Nantes, France; Rivne, Ukraine; Turku, Finland; Umeå, Sweden; Uppsala, Sweden.



Fig. 4. Multi-City – Cohort 2

NetZeroCities supports the EU’s Mission of “100 Climate-Neutral and Smart Cities by 2030” newly-launched as part of the Horizon Europe programme, by seeking to scale the activities of this project across 100 cities, and to tackle the unprecedented capital investments needed to make such a transformation possible.

6 Conclusions

Smart city governance is a complex and dynamic field, essential for shaping the urban future. By developing effective policies and practices, cities can use technology to solve current problems and create more connected, sustainable, and inclusive urban environments. However, to achieve these goals, the involvement of all stakeholders and the adoption of a holistic and integrated approach to smart city governance is crucial.

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