

STUDY REPORT



**Mapping of EU & India's Smart Cities Sector:
Strengths, Market Needs & Opportunities for Business,
Investment & Collaboration
A Thematic Report**

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European Union

Table of Contents

Executive Summary	1
1 Introduction	7
2 The smart cities sector in the European Union	8
2.1 Initiatives and Activities	8
2.2 Strengths and Opportunities	11
2.3 Weaknesses and Challenges	13
3 The Smart Cities Sector in India	13
3.1 Initiatives and Activities	14
3.2 Strengths and Opportunities	16
3.3 Weaknesses and Challenges	18
4 Conclusion: Opportunities for Business, Investment, and Collaboration	19

Abbreviations

Acronym	Definitions
AIA	Amsterdam Innovation Arena
AI	Artificial Intelligence
AIoT	Artificial Intelligence of Things
API	Application Programming Interface
AFD	French Agency for Development
BIS	Bureau of Indian Standards
CAGR	Compound Annual Growth Rate
CSCAF	Climate Smart Cities Assessment Framework
CiX	City Innovation Exchange
DAFM	Data Maturity Assessment Framework
DIF	Digital Investment Forum
DMICDC	Delhi–Mumbai Industrial Corridor Development Corporation Limited
EC	European Commission
EERA	European Energy Research Alliance
EIP-SCC	European Innovation Partnership on Smart Cities and Communities
EIB	European Investment Bank
EIF4SCC	European Interoperability Framework for Smart Cities and Communities
ENoLL	European Network of Living Labs
EPIC	European Platform for Intelligent Cities
ESO	European Standards Organizations
ETSI	European Telecommunications Standards Institute
EU	European Union
EUCF	European Union City Facility
GeM	Government e-Market
GDP	Gross Domestic Product
IUDX	India Urban Data Exchange
IEUP	India-EU Urban Partnership
ICT	Information and Communication Technology
ICC	Intelligent Cities Challenge
ITMS	Intelligent Traffic Management System
ICCC	Integrated Command-and-Control Centre
IIT	International Institute of Information Technology
IISc	Indian Institute of Science
IoE	Internet of Everything
IoT	Internet of Things
IUC	International Urban Cooperation Program
IURC	International Urban and Regional Cooperation

Acronym	Definitions
M2M	Machine to Machine
MeitY	Ministry of Electronics and Information Technology
MoHUA	Ministry of Housing & Urban Affairs
MSW	Municipal Solid Waste
NUDM	National Urban Digital Mission
OneM2M	One Machine-to-Machine Partnership Project
OASC	Open & Agile Smart Cities
OECD	Organization for Economic Co-operation and Development
PPP	Public-Private Partnership
SF-SSCC	Sector Forum on Smart and Sustainable Cities and Communities
SaaS	Software as a service
SC	Smart Cities
SCIS	Smart Cities and Communities Information System
SCADA	Supervisory control and data acquisition
SCM	Smart Cities Mission
SPV	Special Purpose Vehicle
SDO	Standards Developing Organizations
TEC	Telecommunication Engineering Centre
TSDI	Telecommunications Standards Development Society, India
TULIP	The Urban Learning Internship Program
UNaLab	Urban Nature Labs
ULB	Urban local bodies

Executive Summary

One of the issues brought on by fast urbanization is the deterioration of liveability issues related to waste management, limited resources, air pollution, traffic congestion, and ageing public infrastructure. The idea of a smart city has evolved as one of the potential remedies for sustainability challenges resulting from increased urbanization. A smart city strives to become "smarter," more efficient, equitable, sustainable, and liveable, all qualities which are considered necessary for a sustainable future.

At the centre of the "smart city" concept is the idea that information technology and digital data will significantly increase city efficiency. A smart city brings parties together on a platform to launch projects and activities in the areas of living, working, mobility, public space, and connection. A smart city is a unique collaboration between locals, businesses, educational institutions, the digital world, technology, and governmental entities to promote sustainability and quality of life.

In this study, the strengths, gaps, initiatives, and activities in the digital sustainability (smart cities) sector of the EU (and its Member States) and India’s ecosystem have been mapped to identify opportunities relevant to EU-India digital business collaboration and investment. The study also maps the possible collaboration opportunities between the EU and India. The outcomes from the study will drive discussions at the Digital Investment Forum (DIF).

Below is a summary of the smart cities market size in India and Europe, the industry strengths and market needs, and the opportunities for business, investment, and collaboration:

Comparative Highlights of the Smart Cities Market Size of India and the European Union

India	European Union
Smart Cities Market Size	
<ul style="list-style-type: none"> ▪ The smart cities market revenue in India is expected to grow at a CAGR of 19% during the forecast period 2017–2023 to touch an aggregate of EUR 48 billion by 2023¹. ▪ The Indian smart cities IoT market displays a CAGR of 22% during the forecast period 2021-2027². 	<ul style="list-style-type: none"> ▪ Europe’s smart cities market accounted for EUR 184 billion in 2019 and will grow by 17% annually over the 2020-2030 period.³ ▪ In Europe, IoT in the smart cities market was valued at EUR 33 billion in 2020 and is expected to reach EUR 90 billion by 2027 at a CAGR of 16% during the forecast period of 2021-2027⁴.

The above market size comparison reflects that while the smart cities market in the EU is much larger than India’s, and has a higher growth rate, India is also emerging and growing rapidly in the smart cities sector. In terms of technologies for smart cities, IoT applications are increasing at a fast pace in both regions, with India having a higher growth rate.

Key factors driving the development of a European smart cities concept, are a digital transformation and the European goal for transitioning to a low-carbon economy through smart energy management, reductions in emissions, and higher levels of energy efficiency. On the other hand, India is being affected by issues that are slowing urban development and the overall growth of the country's economy. Therefore, India is now betting on smart technologies for its cities' development.

¹<https://www.infoholicresearch.com/press-release/smart-cities-market-in-india-to-reach-47-70-billion-by-2023/>

²<https://www.kbvresearch.com/asia-pacific-iot-in-smart-cities-market/>

³https://www.marketwatch.com/press-release/europe-smart-cities-market-2022-industry-analysis-key-players-data-growth-factors-share-opportunities-and-forecast-to-2030-2022-06-14?mod=search_headline

⁴<https://www.maximizemarketresearch.com/market-report/europe-iot-in-smart-cities-market/9670/>

Comparison of the Industry Strengths of India and the European Union in Smart Cities

India	European Union
<ul style="list-style-type: none"> ▪ As of March 2022, the 100 smart cities have tendered out 6,721 projects worth more than EUR 25 billion; work orders have been issued for 6,214 projects costing more than EUR 20 billion and 3,421 projects worth EUR 7 billion have been completed⁵. The transport sector received the highest percentage. ▪ The main type of Indian Smart cities solutions being deployed in India, which reflect their area of strength, are: IoT solutions for data collection and customer feedback, home automation, micro-grids, smart meters, smart parking systems, area-based traffic control, solar power capacity implementation, air quality monitoring sensors, etc. These can be deployed / shared with the EU ▪ Indian smart city start-ups are innovating in the fields of Artificial Intelligence of Things (AIoT), software as a service (SaaS), big data, machine learning, cloud analytics, wireless (5G, Wi-Fi), and data analytics. These are new areas where innovation is taking place and can be deployed/shared with the EU. ▪ India has implemented measures through Public-Private Partnerships (PPP) (both in investment and development) and the formation of Special Purpose Vehicles (SPV) to plan, appraise, approve, release funds, implement, manage, operate, monitor and evaluate the Smart City projects for faster deployment. 110 PPP projects have been completed and 203 projects are underway with investments worth EUR 3 billion⁶. ▪ India has adopted the OneM2M standards through Telecom Standards Development Society, India (TSDSI) and Telecommunication Engineering Centre 	<ul style="list-style-type: none"> ▪ Horizon Europe will invest around EUR 360 million in research and innovation actions linked to the mission (e.g., in mobility, energy, and urban planning) in the period 2021-2 to develop 100 climate-neutral and smart cities by 2030¹². ▪ The main type of European smart cities projects implemented, which reflect their area of strength, include advanced solutions for building energy management systems, urban data platforms, traffic control systems, travel demand management, demand response, strategic urban planning, mobile applications for citizens, etc. These can be deployed/shared with India. ▪ European start-ups are focusing on developing innovative advanced solutions like community network mobile application, geospatial mapping, IoT using low power wide area network, mobility as a service, IoT for waste and recycling logistics, intelligent cameras using AI and blockchain, and AI for security. Some of these advanced technologies developed by the start-ups are still nascent in international markets like India. ▪ Public-private partnerships have increased collaboration and funding support from the European Commission. ▪ Each smart city or a cluster of smart cities in Europe is associating with the living labs to test the new solutions/technologies with all the stakeholders in the ecosystem. Testing the innovative smart city solutions in the living labs gives EU companies a competitive edge; getting feedback from the ecosystem has significantly improved

⁵ <https://www.smartcitiescouncil.com/article/smart-cities-tenders-6721-projects-worth-rs-188507-crore>

⁶ <https://www.ibef.org/government-schemes/smart-cities-mission>

¹² https://ec.europa.eu/regional_policy/en/newsroom/news/2022/05/05-06-2022-discover-the-100-cities-selected-for-the-cities-mission

India	European Union
<p>(TEC) as national standards in India and are recommended for implementation for the SCM of India.⁷</p> <ul style="list-style-type: none"> ▪ The Bureau of Indian Standards (BIS) has developed smart cities' information and communication technology (ICT) standards also including oneM2M and ETSI Standards to ensure well harmonized, secure, and sustainable digital infrastructure across smart cities. To track the financial and physical progress of the development works for smart cities, the Government of India has developed and maintains a transparent ranking system. ▪ India has developed platforms like the City Innovation Exchange (CiX)⁸ and organising competitions and hackathons to scout new technologies to foster innovative practices and to connect government administrators and urban stakeholders with innovative solutions providers to solve cities' problems. ▪ One of the key strengths has been the set-up of an Integrated Command and Control Centre (ICCC) that acts as the nerve centre” of a smart city and is envisaged to aggregate information through smart-enabled integrated technologies. Seventy cities have established ICCCs to monitor the environment/traffic/water logging/law-and-order situation, which facilitates decision-making and daily operations⁹ ▪ International collaborations: several countries, including France, Spain, Germany and Sweden, have participated in the Union government’s flagship smart city project. Currently, foreign agencies like the French Agency for Development (AFD) – 	<p>the deployment timelines.</p> <ul style="list-style-type: none"> ▪ Technology standardization in the EU is helping facilitate product scalability, representing shared data among systems, and permitting interoperability. There are EU standards being developed for emerging technologies like AI, IoT, M2M, etc., that are being developed for faster adoption of smart city technologies. ▪ The European Telecommunications Standards Institute (ETSI)¹³ is one of the founding members of oneM2M - global standards initiative that covers requirements, architecture, API specifications, security solutions interoperability for Machine-to-Machine and IoT technologies.¹⁴ ▪ Guidelines like the "Citizen data principles"¹⁵ recognize data generated in public places as a public asset and provide a required foundation for more socially responsible access to and use of it by the public and private actors for people-centred smart cities.

⁷ <https://smartnet.niua.org/content/971e8575-bb74-4622-af6f-d6682ef00212#:~:text=The%20Bureau%20of%20Indian%20Standards,digital%20infrastructure%20across%20smart%20cities>

⁸ <https://cityinx.niua.org/>

⁹ https://www.orfonline.org/wp-content/uploads/2021/08/ORF_SpecialReport_155_SmartCitiesMission.pdf

¹³ <https://www.etsi.org/>

¹⁴ <https://www.etsi.org/committee/1419-onem2m>

¹⁵ <https://eurocities.eu/latest/data-people-cities-eurocities-citizen-data-principles-in-action/>

India	European Union
<p>have linked MoUs with states and union territories to participate in developing various smart cities.¹⁰ A Smart City Research Center (living lab) has been established at the International Institute of Information Technology (IIIT), Hyderabad, in collaboration with the Amsterdam Innovation Arena (AIA), Netherlands.¹¹</p>	

Comparison of the Market Needs of India and the European Union in Smart Cities

India	European Union
<ul style="list-style-type: none"> ▪ More coordination and collaborations are needed between governments and the private sector – India needs more coordination between the Central, State and cities agencies for fund disbursement and more collaboration from the private sector to implement new technologies in the smart cities sector. ▪ India needs to invest in more projects that deploy smart and sustainable technologies. ▪ Smart city projects in India need access to more advanced technologies, and more international technologies need to be demonstrated before deployment in India. ▪ India needs a better urban planning ecosystem and needs to focus on a multi-sectoral approach for the development plans. ▪ Need for Capacity Building: people/authorities have limited understanding and know-how about the diverse technologies which have been deployed and used in different smart city projects. ▪ India needs to enhance the implementation of proper frameworks for the development of robust digital infrastructure, and drive more data sharing policies. ▪ Indian smart city projects need to invest more in developing cybersecurity 	<ul style="list-style-type: none"> ▪ The aging population needs simple, user-friendly smart city solutions. ▪ Transitioning from traditional business models towards newer digital business or data-centred models is necessary to create opportunities for local and international companies. ▪ Emerging skills, such as digital, green- and clean-tech skills, are increasingly in demand by European organizations and the market. ▪ EU smart cities need additional policy and funding support from the public and private sectors to accelerate green and digital transformation to achieve climate neutrality by 2050. ▪ More convergence between the national and city authorities is necessary to reflect the needs of the local level.

¹⁰ <https://www.india.com/news/india/several-countries-keen-to-participate-in-smart-city-project-1366266/>

¹¹ <https://smartcityresearch.iiit.ac.in/>

India	European Union
technology and infrastructure.	

Based on the aforementioned synopsis of the comparative market size, industry strengths and market needs in the EU and India, below is a selection of opportunities for the EU to invest in India and for India to invest in the EU:

Opportunities for EU Investment in India

- The technology-driven EU Member States with smart city technologies can explore opportunities in Indian smart city projects. Indeed, France and Germany are currently doing so in collaboration with specific cities in India. The urban renewal and retrofitting program ‘Smart City Mission of India’ invites international tech companies with digital solutions to explore business and project opportunities. In addition, the Indian government has decided to grow the Smart Cities Mission into a movement; this will broaden the smart cities network in the country and create opportunities for EU organizations to collaborate/invest in new smart city projects in the upcoming years.
- Some of the Indian smart city market opportunities that are in demand and prioritized by the government include:
 - Waste management: the EU or the Member States can initiate a program and platform to share technology, know-how and expertise related to digital tech for waste management, especially IoT-enabled solutions. Indian waste management companies and smart city solution providers can be involved to learn about how EU smart cities have implemented digitally-enabled waste management solutions. Business to Business meetings can then be arranged between the EU technology companies involved in the projects, and the Indian companies, to create a roadmap for developing climate-smart cities.
 - Cybersecurity solutions.
 - Smart water-related solutions to India.
 - Smart grid connectivity solutions with decentralized generation from renewable energy sources.
- There is a lack of financing for smart city projects in India leaving the door open for EU financing for business and investment.
- The European Network of Living Labs (ENOLL) can share knowledge and best practices to support Indian cities with the set-up of living labs in smart cities and also by connecting them to European living labs. Furthermore, ENOLL can facilitate the testing of EU tech in Indian smart city living labs and vice versa. This can facilitate technology access, testing, deployment opportunities to enhance business and investment.
- European private sector companies can also explore the opportunity to invest in Indian smart cities by taking up to 30% of the share in the Special Purpose Vehicle (SPV) of the Smart Cities Mission (SCM).
- The Government of India organizes open innovation challenges to target innovations from start-ups, SMEs, corporations and individual innovators across different sectors and themes. European technology companies can collaborate with Indian organizations to use this open data from the India Urban Data Exchange (IUDX) and develop innovative solutions for urban challenges.
- The European Commission Cities Mission for the period 2021-2027 could invite the Indian Smart Cities Mission for best practice and technology exchange, and create a long-term platform for enabling cities to advance with digital and green transformation. This can lead to the opening of

business and investment opportunities for both sides

- The European Commission can provide funding for EU smart city start-ups with innovative advanced technologies, and support with accessing the emerging Indian smart cities market.

Opportunities for India to Invest in the EU

- Indian smart city solution companies can explore business and market entry opportunities in the EU via the EU smart city networks and initiatives. The ENOLL living labs in European cities can present a testing ground for Indian tech companies to access EU markets.
- Collaboration with EU start-ups and SMEs provides further opportunity for Indian start-ups to foray into the European smart city market, in particular where the EU start-ups and SMEs are piloting in European smart city projects. European smart city projects can also consider opening up “City Challenges” to Indian start-ups and SMEs.
- Indian innovative start-ups already working with several smart cities in India in the digitalization of water and waste management / energy efficiency can identify partnership opportunities in Europe and actively participate in developing solutions through joint research and development programs, or cross-border collaborations.
- The SPV of the Indian SCM could share their experience in utilizing the existing ICT infrastructure, and collaborate with European organisations to develop frugal innovations that could bring 2-3 times more profit than the existing infrastructure, rather than going in for a lot of high initial capital expenditure. Therefore, India can invest in developing frugal innovation in collaboration with EU organisations, that can bring the cost down for the deployment of smart city solutions in Europe.
- Indian smart city tech companies could explore EU opportunities to collaborate on co-developing innovative energy services for the Indian smart cities, as there is much emphasis on climate-smart cities in Europe and India.
- India can play a role in integrating smart solutions to simplify the applications, and address the aging population-related issues in the EU because of the associated low cost of developing the solutions.
- India could share resources with European organizations in need of a digital skills and talent pool, such as digital, green- and clean-tech skills for smart city applications. One such area for collaboration is mobility and electric vehicles for cities. India has a growing set of start-ups, SMEs, and large companies focused on digital solutions for mobility and electric vehicles.
- Indian public, private sector and research and development organisations could identify and learn best practices from the completed European smart city research and development projects and later adapt the results/recommendation from the research projects to the Indian scenario instead of developing new solutions. Setting up this bridge could be a worthy investment for Indian stakeholders. More such collaborations like Smart City Research Center in IIT, Hyderabad and the AIA can be encouraged.

The Smart Cities Sector in the European Union and India

A Thematic Report Mapping the Strengths & Opportunities and the Weaknesses & Challenges

1 Introduction

The leaders of the EU-India Summit 2020 agreed to organize a high-level Digital Investment Forum (DIF) to explore associated opportunities and challenges with stakeholders from both sides. The DIF is a platform that offers opportunities to achieve some of the goals outlined in the EU-India Roadmap 2025¹⁶ and the EU-India Connectivity Partnership¹⁷. Since November 2020, the EU Delegation to India has hosted a series of events to elicit input from various stakeholders in preparation for the DIF, which has resulted in the identification of four areas to explore for further cooperation: cybersecurity, healthcare, smart cities, and microelectronics.

The primary goal of this study is to map EU (and its Member States) and Indian ecosystems' strengths, weaknesses, initiatives, and activities in the smart cities sector, to identify potential opportunities for sectoral EU-India digital collaboration and investment. The outcomes of this study will feed into the discussions to be conducted at the DIF.

The preparation of this study followed a methodology that applied secondary research, virtual surveys, and focused group discussions during which the initial findings were presented to key informants and subject experts from the EU and India, who provided additional inputs that enriched the analysis.

The smart city is a concept to efficiently improve traditional networks and services using digital solutions for the benefit of residents and businesses. It has better connected urban **transport**, upgraded **water supply & waste disposal facilities**, and more efficient buildings, **lighting and heating** systems. These cities are also envisioned to have more interactive and responsive city **administration**, **safer public spaces**, and better able to meet the **needs of an aging population**¹⁸. Smart cities have a huge role in creating urban areas which are both sustainable and efficient, curtailing the energy requirement of future cities.

Smart cities need digital solutions to be identified and put in place, which can produce smart outcomes and assist in the development of cities by appending digital intelligence to existing urban systems, making it possible to do more with less. Connected digital applications put real-time, transparent information into the hands of users to help them make better choices. As a result, they can save time, reduce waste, and even help boost social connectedness, and over time, become a lighthouse for other cities.

Some of the key drivers of digital technologies in smart cities include:

- **Security system:** city surveillance - the Intelligent Traffic Management System (ITMS) enables users to be better informed and to make safer, more efficient, coordinated, and smarter use of transport networks.
- **Healthcare:** virtual consultation and monitoring existed long before the COVID-19 pandemic but they are also fast becoming a preferred method for the first point of contact between patients and healthcare providers.

¹⁶https://www.mea.gov.in/bilateral-documents.htm?dtl/32828/IndiaEU_Strategic_Partnership_A_Roadmap_to_2025

¹⁷https://www.consilium.europa.eu/media/49522/eu-india_connectivity-factsheet_2021-05-final.pdf

¹⁸https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en

- **New age mobility:** electrification of transportation and smart mobility solutions are becoming key to reduce the dependence on fossil fuels and transportation related emissions.
- **Energy, water and waste:** smart waste and used water management is a new frontier for local authorities looking to reduce municipal solid waste, water wastage and to boost community recycling rates.

The World Economic Forum estimates that the combined global value of digital transformation to society and industry will exceed EUR 100 trillion by 2025.¹⁹ A similar trend has also been observed in India as the digital transformation market is on its way to hitting the EUR 710 billion mark by 2024. In percentages, this amounts to a CAGR of 74%. Considering this figure, it can be safely said that the services and technology industry in the country is progressing at a brisk pace.

Currently, many smart applications are already being used in infrastructure-based services in security, healthcare, mobility, energy, water, waste, economic development, housing, engagement, and community. Some of the smart city applications include the following elements:

- smart grids helping to manage energy consumption;
- smart meters and pipes allowing for tracking water quality and leak detection;
- smart sensors improving traffic flow, transport efficiency, and solid waste collection routes; and
- mobile applications enabling citizens to report problems in real-time and engage directly with city services.

This report focuses on the digital aspects of energy efficiency, water, and waste collection in smart cities.

2 The smart cities sector in the European Union

European societies have been experiencing a radical digital transformation and speeding up many kinds of interaction through the increasing number of connected devices and data flows. Transitioning to a low-carbon economy is currently a primary European goal. The key aspects of a low-carbon economy include higher levels of energy efficiency through support for smart energy management, and reductions in emissions.

2.1 Initiatives and Activities

Below is a selection of initiatives and actions of the EU which has been identified through extensive desk research and online sources:

- **EU Mission: Climate-Neutral and Smart Cities²⁰:** the Cities Mission will involve local authorities, citizens, businesses, investors along with regional and national authorities to **deliver 100 climate-neutral and smart cities by 2030 and ensure that these cities act as experimentation and innovation hubs to enable all European cities to follow suit by 2050**. The mission will cover a wide range of subjects such as urban planning and design for climate-neutral cities, sustainable urban mobility, and positive and clean energy districts. **On 28 April 2022, the Commission announced the 100 participating cities** which will receive the Commission's support in achieving the goal of climate-neutral and smart cities by 2030²¹. The mission platform will provide the necessary technical, regulatory and financial assistance to cities. In total, **Horizon Europe will invest around EUR 360 million** in research and innovation actions linked to the mission (e.g., in mobility, energy, and urban planning) in the period 2021-23.

¹⁹ <https://www.weforum.org/press/2016/01/100-trillion-by-2025-the-digital-dividend-for-society-and-business/>

²⁰ https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe/climate-neutral-and-smart-cities_en

²¹ https://ec.europa.eu/info/sites/default/files/research_and_innovation/funding/documents/ec_rtd_he-cities-mission-reveal-factsheet.pdf

- The **European Commission proposed Digital Decade**²² - a concrete plan to achieve the digital transformation of society and the economy by 2030 – which paves the way for the twin digital and green transformation of the energy sector to benefit from state-of-the-art digital solutions with lower environmental footprints and higher energy and material efficiency, leading to a more resilient, efficient and greener energy system in the smart cities sector.
- In 2020, the **Smart Cities Marketplace**²³ (SCM) was created by merging two former Commission projects. The SCM is a hub for all stakeholders, groups, networks, platforms, industries, SMEs, investors, researchers, and initiatives involved in the smart city field.
- The **Living-in.EU**²⁴ movement is building "The European way of digital transformation in cities and communities" based on the declaration launched for signatures by the Finnish EU Presidency in 2019.
- The **Smart Cities and Communities Lighthouse Projects** - Since 2014, 120 cities have deployed over 500 solutions in more than 20 countries through this initiative²⁵. These 120 cities are represented as scalable cities and include 48 ‘Lighthouse cities’ and 72 ‘Fellow cities’. Lighthouse cities are cities that pilot and deploy the most advanced and innovative solutions. Below is a selection of the technological solutions implemented in these lighthouse cities²⁶:
 - Building energy management system: smart home system, energy visualization, smart plugs, connected lighting and thermostats, and smart meters.
 - Neighbourhood energy management system: energy production systems in the area such as photovoltaic systems.
 - Urban data platform: big open data platform, semi-automatic instance mapping.
 - Traffic control system: smart guiding to alternative fuel stations and fast charging, traffic signals synchronized to prioritise certain vehicle movements of goods, improved parking management, detailed assessment for parking spaces, and public transport platform.
 - Travel demand management: mobility smart city platform and development of advanced mobility services.
 - Demand response: smart meter information analysis and actuators.
 - ICT as planning support: weather metering predicting the storage, virtual power plant, virtual power plant managed batteries for renewable energy storage, innovative ICT application (WoonConnect), interactive design and process for dwelling improvement (WoonConnect), smart benches, smart waste, smart watering, intelligent lamp posts, local goods distribution centres, shared economic services, smart gateway for public/residential buildings, innovative video solutions and visual communication tool.
 - Mobile applications for citizens: smart city application giving access to services like authentication, payment, energy performance visualization.
 - Strategic urban planning: sensor network in the public space (fiber-optic data infrastructure), open Wi-Fi, sound/video and air quality sensors.

²²https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en

²³<https://smart-cities-marketplace.ec.europa.eu/>

²⁴<https://living-in.eu/>

²⁵<https://smart-cities-marketplace.ec.europa.eu/news-and-events/news/2022/more-half-selected-eu-mission-100-cities-are-scalable-cities>

²⁶https://smart-cities-marketplace.ec.europa.eu/sites/default/files/2021-04/the_making_of_a_smart_city_-_best_practices_across_europe.pdf

- **Open & Agile Smart Cities (OASC)**²⁷, active in EU projects such as Synchronicity and Rural, brings together smart cities and communities worldwide to shape the global market for digital services.
- **SELECT4Cities**²⁸–SELECT4Cities aims to design, research, and develop a data-driven, Internet-of-Everything (IoE) platform for European cities to enable large-scale co-creation, testing, and validation of urban IoE apps and services.
- The **EU Covenant of Mayors for Climate & Energy**²⁹ brings together thousands of local governments voluntarily committed to implementing EU climate and energy objectives.
- **Energy Cities**³⁰ is the European association of local authorities in energy transition. Created in 1990, the association represents over 1,000 towns and cities in 30 countries. Its main objectives include strengthening cities' roles and skills in the field of sustainable energy, representing their interests and influencing EU policies, exchanging experiences, transferring know-how, and implementing joint projects.
- The **EU City Facility (EUCF)**³¹ set up under the Horizon 2020 Framework Program for Research and Innovation of the European Union, the EUCF will unlock local potential and support local authorities and their groupings with tailor-made, fast and simplified financial support (in the form of EUR 60,000 lump sums) and related services to enable municipalities in Europe to develop relevant investment concepts related to the implementation of actions identified in their climate and energy action plans.
- The **European Energy Research Alliance (EERA)**³² is the joint program on smart cities that aims to develop new scientific methods, concepts and tools designed to support European cities in their transformation into smart cities. The key focus is on the large-scale integration of renewable energies and enhanced energy efficiency, enabled through smart energy management at city level.
- The **Intelligent Cities Challenge (ICC)**³³ is a European Commission initiative that supports 136 cities using cutting-edge technologies to lead the intelligent, green and socially responsible recovery from the COVID-19 pandemic. The ICC cities and their local ecosystems will be engines for recovering their local economies, creating new jobs, and strengthening citizen participation and well-being.
- **CitySDK**³⁴ creates a toolkit to enable more efficient utilization of the expertise and know-how of developer communities to be applied in city development. The toolkit comprises open and interoperable digital service interfaces, processes, and usability standards.
- The **European Platform for Intelligent Cities (EPIC)**³⁵ – combines innovation ecosystem processes, fully researched and tested e-Government service applications, and new cloud computing technologies to create the first truly scalable and flexible pan-European platform for innovative, user-driven public service delivery, along with a user road map.
- **The Urban Nature Labs (UNaLab)**³⁶–The project will demonstrate innovative nature-based solutions in cities facing climate change and urbanization challenges. Through the project, locally-attuned innovative water management systems will be co-created and shown in the context of an integrated urban ecological approach.

²⁷ <https://oascities.org>

²⁸ <https://www.select4cities.eu/>

²⁹ <https://www.eumayors.eu/about/>

³⁰ <https://energy-cities.eu/>

³¹ <https://www.eucityfacility.eu/about/what.html>

³² <https://www.eera-set.eu/about-us/what-is-eera.html>

³³ <https://www.intelligentcitieschallenge.eu/about-intelligent-cities-challenge>

³⁴ <https://www.citysdk.eu/about-the-project/what-is-citysdk/>

³⁵ <https://epicamif.eu/>

³⁶ <https://unalab.eu/en>

- The **European Network of Living Labs (ENOLL)**³⁷ is the international, non-profit, independent association of benchmarked Living Labs. ENOLL facilitates knowledge exchange, joint actions and project partnerships between its historically labelled +480 members worldwide and in Europe. Furthermore, it aims to promote the Living Labs concept to influence EU policies, enhance Living Labs and enable their implementation on a global scale.

2.2 Strengths and Opportunities

Here below are the strengths and opportunities in the Smart Cities sector in the EU:

- The European smart cities market was valued at **EUR 187 billion in 2019 and will grow by 16.8% annually over 2020-2030** owing to the rising need for resource management due to overpopulation and emerging technological advancements in 5G, AI, big data, IoT, cloud and edge computing.³⁸
- In Europe, the **IoT in the smart cities market was valued at EUR 33 billion in 2020** and is expected to **reach EUR 90 billion by 2027 at a CAGR of 16%** during the forecast period of 2021-2027³⁹.
- In a study entitled ‘Smart City Projects Implementation in Europe⁴⁰ - Assessment of Barriers and Drivers’, the most impactful strengths in Europe are reported to be **cooperation among stakeholders** and **marketing applications for awareness and involvement**. One such initiative by the European Commission is the Smart City Marketplace⁴¹, to advance the market for smart and sustainable city solutions while ensuring a mutual level playing field for all smart city stakeholders within the European regulatory framework.
- European cities are pioneers in testing and implementing innovative, sustainable and integrated solutions to become greener, more efficient, and better places. City governments have fostered territorial and multi-level collaboration and increasingly developed a broader smart city vision while working at an EU level and on local projects and initiatives⁴².
- European start-ups have developed innovative smart city solutions using advanced technologies such as:
 - the community network mobile application (Public Square, Onhys),
 - geospatial mapping (Mapillary, Bareways),
 - IoT using Low Power Wide Area Network (Sigfox, eLichens, THING-IT)⁴³,
 - mobility as a service (Tier Mobility, Vesputi),
 - IoT for waste and recycling logistics (Enevo),
 - intelligent cameras using AI and Blockchain (Natix⁴⁴),
 - machine learning & big data (Breeze Technologies), and

³⁷ <https://enoll.org/projects/>

³⁸ https://www.marketwatch.com/press-release/europe-smart-cities-market-2022-industry-analysis-key-players-data-growth-factors-share-opportunities-and-forecast-to-2030-2022-06-14?mod=search_headline

³⁹ <https://www.maximizemarketresearch.com/market-report/europe-iot-in-smart-cities-market/9670/>

⁴⁰ https://smart-cities-marketplace.ec.europa.eu/sites/default/files/sinfonia_smart_city_projects_implementation_in_europe_-_assessment_of_barriers_and_drivers.pdf

⁴¹ <https://ec.europa.eu/newsroom/ener/newsletter-archives/24723>

⁴² <https://eurocities.eu/goals/smart-cities-digital-transformation/>

⁴³ <https://www.eu-startups.com/2018/11/10-european-startups-that-are-making-our-cities-smarter/>

⁴⁴ <https://www.natix.io/>

- artificial intelligence for security (1702ai, DeepNeuronic)⁴⁵.

Some of these advanced technologies developed by the start-ups are nascent in other regions like India. They have also developed solutions for building energy management systems, urban data platforms, traffic control systems, travel demand management, demand response, strategic urban planning, and mobile applications for citizens, etc. There is an opportunity for these start-ups to explore international markets and deploy solutions in emerging Indian smart cities.

- One of the latest evolutions within smart cities projects is the implementation of living labs; they promote the idea achievable through a smart city and represent a new way to bring together city managers and all the urban actors to create an innovation-oriented environment. These living labs consist of real-life settings in which every actor plays a fundamental role, especially citizens, through their activities towards the co-creation of new services, products, and societal infrastructures thanks to user-driven innovation.⁴⁶
- The **standardization** of emerging technologies helps in scaling the products, representing common data among systems and allowing interoperability. The EU published a smart cities proposal for interoperability: ‘European Interoperability Framework for Smart Cities and Communities (EIF4SCC)’⁴⁷, to provide EU local administration leaders with definitions, principles, recommendations, including practical use cases, and a common model that enables public service delivery across domains, cities, regions, and borders⁴⁷. Standardization has also produced a change in the smart water industry. The smart water sector, previously immersed in adopting private water management and monitoring standards, has evolved to adopt open standards⁴⁸.
- **One Machine-to-Machine Partnership Project (OneM2M)**: Formed in 2012, oneM2M is the global standards initiative that covers requirements, architecture, API specifications, security solutions interoperability for Machine-to-Machine and IoT technologies. Moreover, oneM2M specifications provide a framework to support applications and services such as smart grid, connected car, home automation, public safety, health and other sectors.⁴⁹ ETSI is one of the founding members of oneM2M.
- Digital technologies are increasingly applied across almost all areas of waste collection. As a result, certain aspects of the collection have improved by advances in digitalization, especially logistics, which is understood to mean the process of organizing, scheduling and dispatching tasks, personnel and vehicles.
- A smart city or a cluster of smart cities in Europe would be associated with the living labs where they work with the overall ecosystem to test the new solutions/technologies with all the stakeholders, with a strong emphasis on the city, societies and citizens. Testing the innovative smart city solutions in the living labs gives the European companies a competitive edge, as they would get feedback from close to the real ecosystem and then can improve the products before the final rollout.
- For people-centred smart cities, guidelines such as the ‘Citizen data principles’⁵⁰ recognize data generated in public spaces as a public asset and provide a necessary starting point for more socially responsible access to it and its use by the public and private actors. The Declaration of Cities Coalition for Digital Rights⁵¹ addresses transparency, accountability and non-discrimination of data. It expresses a crucial

⁴⁵ <https://thenextweb.com/news/these-startups-making-smart-cities-safer>

⁴⁶ <https://go.gale.com/ps/i.do?p=AONE&u=googlescholar&id=GALE%7CA497612185&v=2.1&it=r&sid=googleScholar&asid=3251791b>

⁴⁷ <https://joinup.ec.europa.eu/collection/nifo-national-interoperability-framework-observatory/document/proposal-european-interoperability-framework-smart-cities-and-communities-eif4scc>

⁴⁸ <https://joinup.ec.europa.eu/collection/rolling-plan-ict-standardisation/water-management-digitalisation-0>

⁴⁹ <https://tsdsi.in/tsdsi-transposed-onem2m-rel-2-approved-for-adoption-as-national-standard-by-telecom-engineering-centre-tec/>

⁵⁰ <https://eurocities.eu/latest/data-people-cities-eurocities-citizen-data-principles-in-action/>

⁵¹ <https://citiesfordigitalrights.org/thecoalition>

commitment for smart cities to responsibly use data and protect citizens' fundamental digital rights⁵².

2.3 Weaknesses and Challenges

Here below are some of the weaknesses and challenges in the smart cities sector in the EU:

- One very practical issue in Europe is the aging population; older people with a limited understanding of the usage of smart city applications need simple, user-friendly solutions.
- **There is no unified approach to public-private collaboration throughout the EU.** The challenge is in identifying the right approach for smart cities project implementation between the following – (i) working with companies to see how they can help to implement municipality/city-driven initiatives with their vision versus (ii) business-driven initiatives that rely more on companies to develop, test and present innovative approaches for developing smart cities⁵³.
- **Emerging requirements of skills, such as digital, green- and clean-tech skills,** are a pressing challenge, and increasingly demanded by organizations and the market⁵⁴. Many European cities and regional governments increasingly face skills gaps in both the public and private sectors. Research shows that 79% of CEOs say that a lack of key skills is threatening the future growth of their organisation and 8 out of 10 EU companies find that the limited availability of adequately skilled staff impedes investment⁵⁵.
- Cities play a pivotal role in achieving climate neutrality by 2050, the goal of the European Green Deal. Cities consume over 65% of the world's energy and account for more than 70% of global CO₂ emissions. Since climate mitigation depends on urban action, EU cities need support and public and private coordination in accelerating green and digital transformation.
- Some EU Member States have adopted national legislation to foster sharing of privately held data with authorities. However, **national data-sharing frameworks are based on needs and objectives that do not always reflect those of the local level.** City authorities also often lack implementation support. This situation creates a fragmented governance system based on ad-hoc practices that are difficult to replicate or upscale across the EU.⁵⁶
- **Pre-existing digital infrastructure is necessary** for many of the new smart city solutions to function properly since they rely on a well-balanced system of regulatory frameworks, internet access, mobile network coverage, standards for data interchange, interfaces, and public digital literacy.

3 The Smart Cities Sector in India

On 25 June 2015, Prime Minister Narendra Modi announced India's Smart Cities Mission (SCM)⁵⁷. This project aims to drive economic growth and improve the lives of urban citizens across the country by enabling local area development and harnessing smart technology. A total of one hundred cities in different States, that are home to more than one-third of the country's population, have been selected to be turned into smart cities. Together, they have pitched over EUR 26 billion as their total investment budget to facilitate the realization of more than 5,000 projects designed to improve their management and infrastructure.

While an increasing number of people are migrating from rural to urban areas to seek economic opportunities, issues such as poor local governance and financing, a lack of infrastructure and services, and inappropriate

⁵² <https://eurocities.eu/latest/privacy-in-the-smart-city/>

⁵³ <https://www.forbes.at/artikel/public-or-private-building-smart-cities.html>

⁵⁴ <https://www.intelligentcitieschallenge.eu/sites/default/files/2021-10/A%20pragmatic%20guide%20to%20reskilling-FINAL.pdf>

⁵⁵ PwC – Talent trends 2019. Upskilling for a digital world. Part of PwC's Annual Global CEO Survey trends series

⁵⁶ https://eurocities.eu/wp-content/uploads/2020/07/EUROCITIES-statement-on-B2G-data_forExcom.

⁵⁷ <https://smartcities.gov.in/>

and archaic urban planning represent enormous challenges that hinder the integration of migrants in cities. The growing urban population is also putting tremendous pressure on resources like water and energy and overwhelming waste management services, public transport, education, and healthcare. To tackle this urban explosion, India is now betting on smart technologies. This new approach would allow the government to use its resources and plan its infrastructure development more sustainably and efficiently, not to mention improve overall city operations.

3.1 Initiatives and Activities

Below is a selection of initiatives and actions in India which have been identified through extensive desk research and online sources:

- **Smart Cities Mission (SCM)**⁵⁸: the main objective of the SCM is to promote cities that provide core infrastructure, a clean and sustainable environment and give a decent quality of life to their citizens through the application of ‘smart solutions’. Some of the government initiatives under the SCM are enumerated below⁵⁹.
 - **Smart Transport**: The Ministry of Urban Development has invested more than EUR 20 billion in upcoming metro rail projects. India's first monorail project in Mumbai costs around EUR 500 million, of which EUR 183 million has been spent on phase I.
 - **Smart Information and Communication**: this initiative focuses on broadband connections to 175 million users. Under the flagship 'Safe City' project, the Union Ministry has given EUR 333 million to make seven big cities (Delhi, Mumbai, Kolkata, Chennai, Ahmedabad, Bengaluru, and Hyderabad) the focus for technological advancement.
 - **Smart Buildings**: India is expected to emerge as the world's 3rd largest construction market by adding 12 million homes every year. Smart buildings will save up to 30% of water and 40% of energy consumption, and reduce building maintenance costs by 10 to 30%.
 - **Smart Governance**: EUR 83 million was allocated to the Digital India Initiative. The PPP model is being used to upgrade infrastructure in 500 urban areas. For example, Delhi–Mumbai Industrial Corridor Development Corporation Limited (DMICDC) has planned seven such smart cities along the 1,500 km industrial corridor with a total investment of EUR 100 billion.
 - **Smart Energy**: this initiative established smart grid testbeds and smart grid knowledge centres, implementing eight smart grid pilot projects in India with an investment of EUR 10 million and installing 130 million smart meters by 2021.
- The **City Innovation Exchange (CiX)**⁶⁰ – is a platform launched in February 2021 to focus on fostering innovative practices in cities involved in the platform. It will bring together citizen organisations, academia, businesses, and the government to co-create for the future of urban India in a transparent and sustainable manner. The platform will ease the discovery, design and validation of solutions through a robust, transparent and user-centric process that will reduce barriers for innovators and cities to discover fitting solutions. The platform had more than 400 start-ups, 100 smart cities, more than 150 challenges statements and over 215 solutions at the time of launch. In due time, the CiX platform will contribute immensely to the ease of doing business and ease of living in cities.
- The **National Urban Digital Mission (NUDM)**⁶¹ was launched in February 2021, with the goal of building shared digital infrastructure in all of India’s urban centers by 2024. NUDM will apply open Application Programming Interfaces (APIs) to encourage interoperability and greater stakeholder

⁵⁸ <https://smartcities.gov.in/>

⁵⁹ <https://www.stl.tech/sterlite-live/pdf/whitepapers/smart-cities-in-india-creating-a-smarter-nation.pdf>

⁶⁰ <https://cityinx.niua.org/home>

⁶¹ <https://nudm.mohua.gov.in/>

involvement, and has already gained partnerships with urban governments, industry associations, academia, civil society, and entrepreneurs.

- The **India Urban Data Exchange (IUDX)**⁶²: the IUDX is a transformative initiative of the Ministry of Housing and Urban Affairs, Government of India, to provide a data exchange platform to Indian cities. The IUDX serves as a seamless interface for data providers and users, including Urban Local Bodies (ULBs), to share, request, and access datasets related to cities, urban governance, and urban service delivery. The platform has been developed by the Smart Cities Mission and is implemented by the Indian Institute of Science (IISc), Bengaluru. The IUDX has adopted BIS standards on smart infrastructure, similar to EU standards developed by the ETSI for APIs and smart cities.
- **SMARTNET**⁶³: Smartnet is an initiative of the Ministry of Housing & Urban Affairs (MoHUA) to support the development of cities across India and to create a resource-rich ecosystem of learning, sharing and dissemination for city managers and primary stakeholders in the urban transformation of India. The key objectives of Smartnet are: providing a horizontal learning and knowledge sharing platform for exchange between cities, practitioners, academia, researchers and technologists; Evolving a comprehensive framework to visualize and articulate the government's urban sector missions.
- The **Data Maturity Assessment Framework (DAFM)- Cycle 2**: the core objective of this framework is to enable cities to assess their own data maturity with respect to a standardized framework covering aspects of enabling policies, governance structures, data management, capacity building, and stakeholder engagement at city level. This is expected to play an enabling role in democratizing the data culture for open- innovation, collaboration, co-creation and academic research.
- The **Climate Smart Cities Assessment Framework (CSCAF) 2.0**⁶⁴: this initiative was launched in September 2020 to provide a clear roadmap for cities towards combating climate change, while planning and implementing their actions, including investments. The CSCAF initiative intends to inculcate a climate-sensitive approach to urban planning and development in India.
- The **Urban Learning Internship Program (TULIP)**⁶⁵: this program aims to provide internship opportunities to 25,000 fresh graduates in all Urban Local Bodies (ULBs) and smart cities across the country. The internship opportunities will be provided for 'Smart City' projects which range from positions in urban planning, water supply, waste management, slum improvement and digital governance.

Excerpt of EU – India initiatives in the smart cities sector:

- The **International Urban Cooperation Program (IUC)**⁶⁶: the IUC has been supporting cities in delivering on the pathways to a green and inclusive recovery and boosting adequate investment in environmentally friendly technologies, to generate and support innovation. Under IUC India, 11 city pairings worked together during the period 2017-2020, and drafted action plans, developed concrete cooperation activities, and agreed on pilot projects. For instance, Surat has worked to replicate a water plaza concept from Rotterdam for one of its riverside neighbourhoods to allow excess rainwater from the monsoon season to recharge groundwater aquifers for later use during the dry season while converting a waste dumpsite into a recreational green space for the public. Building on the IUC's success, a second phase was launched in 2021, called **International Urban and Regional Cooperation (IURC)**. With the IURC, the EU will continue to support cities in India to drive sustainable development and climate action by investing in 14 new cities on each side to exchange experience on sustainable urban development.

⁶² <https://iudx.org.in/>

⁶³ <https://smartnet.niua.org/>

⁶⁴ <https://niua.in/csc/>

⁶⁵ https://internship.aicte-india.org/module_ulb/Dashboard/TulipMain/

⁶⁶ https://ec.europa.eu/regional_policy/en/policy/cooperation/international/india/

- The **India-EU Urban Partnership (IEUP)⁶⁷: commissioned in 2020**, the IEUP is a 3-year strategic project between the MoHUA and the EU delegation to India that aims to support smart, sustainable and resilient urbanisation in India.

3.2 Strengths and Opportunities

Here below are the strengths and opportunities in the Smart Cities sector in India:

- **Smart city market** - The smart cities market revenue in India is expected to grow at a CAGR of 19% during the forecast period 2017–2023 to reach an aggregate of EUR 48 billion by 2023⁶⁸. As of March 2022, the 100 smart cities have tendered out 6,721 projects worth more than EUR 25 billion; work orders have been issued for 6,214 projects costing more than EUR 20 billion and 3,421 projects worth EUR 7 billion have been completed⁶⁹. The transport sector received the highest percentage of the total amount budgeted through the SCM, followed by energy and ecology, water and sanitation, housing, and economy.
- The Indian smart cities IoT market is touted to display a CAGR of 22% during the forecast period 2021-2027⁷⁰.
- **100 smart cities in India**, which are part of the smart cities mission in India, have developed/ been working with technologies, for instance home automation solutions; collecting customer feedback via IoT and digital channels; smart energy consumption; micro-grid; smart meters; smart parking system; smart meters for electricity; solar power capacity implementation; and many more.
- **International Connectivity** - Technology-driven countries like Spain, France, Germany, Sweden etc., are supporting various Indian smart cities through the best technology and services. For example, France is supporting three Indian cities—Chandigarh, Nagpur, and Puducherry and is planning to invest EUR 1 billion⁷¹. Germany has also set up a deal with India to develop Bhubaneswar (Odisha), Kochi (Kerala) and Coimbatore (Tamil Nadu) as smart cities. The Ministry of Electronics and Information Technology (MeitY), the SCM of India and the state of Telangana, have institutionalized a Smart City Research Center (living lab) at the International Institute of Information Technology (IIIT), Hyderabad, in collaboration with the Amsterdam Innovation Arena (AIA), Netherlands.⁷²
- **Fast Pace Working Culture** – SPVs have been set up to implement the SCM projects at city level. The SPVs are tasked with planning, appraising, approving, releasing funds, implementing, managing, operating, monitoring and evaluating the smart city development projects. The formation of SPVs has enhanced working efficiency and results in a time-bound manner. The private sector can also explore the opportunity to invest in smart cities by directly taking up to a 30% share in the SPV. 110 PPP projects have been completed and 203 projects are underway with investments worth EUR 3 billion.
- **Faster Implementation** - The SCM development projects (like ITMS, solid waste management, river front development, ICCC etc.) have been taken under convergence and PPP mode; hence the engagement of multi-stakeholders in the projects results in both the financial aspects and the risk being shared amongst the parties, thereby **expediting the approval processes and implementation** of the projects.
- **Integrated Command and Control Centre (ICCC)**: all SMC projects have been mandated to setup ICCCs to house all the necessary ICT interventions like servers, adaptive traffic control systems, integrated traffic management systems, security surveillance, etc., thus creating the ICT backbone for

⁶⁷ <https://www.ieup.eu/>

⁶⁸ <https://www.infoholicresearch.com/press-release/smart-cities-market-in-india-to-reach-47-70-billion-by-2023/>

⁶⁹ <https://www.smartcitiescouncil.com/article/smart-cities-tenders-6721-projects-worth-rs-188507-crore>

⁷⁰ <https://www.kbvresearch.com/asia-pacific-iot-in-smart-cities-market/>

⁷¹ <https://economictimes.indiatimes.com/news/economy/infrastructure/france-expresses-willingness-to-help-make-chandigarh-smart/articleshow/49324798.cms>

⁷² <https://smartcityresearch.iiit.ac.in/>

implementing other smart solutions. This enables the existing infrastructure to be upgraded and creates the opportunity to use better and faster solutions that are available on the market. Of the cities included in the SCM, 70 have established ICCCs to monitor the environment/traffic/water logging/law-and-order situation, which facilitates decision-making and daily operations⁷³.

- **City Ranking Systems**⁷⁴ are a transparent ranking system designed by the Government of India to monitor the financial and physical progress of the development works of the smart cities, based on various parameters like ease of living and quality of urban governance. The ranking system encourages friendly competition amongst the SCM projects to promote faster adoption of technologies.
- Indian ministries have been organizing competitions and hackathons to scout new digital technologies for solving smart city issues in India. These competitions provide seed funds for start-ups to promote innovations. These smart cities have also fostered a platform to establish connections between the government administration and urban stakeholders with innovative solutions to solve the issues in urban landscapes. For example, the Swachh Survekshan⁷⁵ conducted by the MoHUA promotes the use of the latest technologies and innovations to **improve waste management** in cities, which in turn provides an opportunity/platform for these smart cities to scout new technologies from private players as well as from start-ups.
- Indian smart city-related tech start-ups have experience working in the field of AIoT, SaaS, big data, machine learning, cloud analytics, wireless (5G, Wi-Fi), and data analytics.
- **Standardized Process** -the BIS, in association with the Smart Cities Mission, the MoHUA has developed smart cities ICT standards for ensuring well harmonized, secure, and sustainable digital infrastructure across smart cities.⁷⁶ Consequently, the guidelines and modus operandi are in place to execute smooth and effective ICT/IoT-related infrastructures across 100 smart cities. The **standardized guidelines help deploy new smart cities faster**, hence helping to scale up.
- Telecommunications Standards Development Society, India (TSDI) has transposed **the oneM2M specification Release 2 as a national standard for the IoT service layer for SCM in India**. Which, were approved by the Telecom Engineering Centre (TEC)⁷⁷. These specifications address the need for common M2M service layer that can be readily embedded within various hardware and software, relied upon to connect the myriad of devices in the field with M2M application servers worldwide. These transposed documents cover M2M functional architecture, requirements, service layer control protocols, Management enablement etc. These TEC standards have been included by BIS in its standards on IoT reference architecture (part of smart city standards) along with the ETSI standards and were released in June 2021. These Standards have been issued as an advisory by MoHUA for the SCM SPVs.⁷⁸
- One of the objectives of India's SCM is **to create more from less** using the existing infrastructure available in the city. The SPVs of the Smart City Mission focuses on utilizing the existing infrastructure that is present in the cities. The solutions developed through frugal innovations bring 2-3 times more profit than the existing infrastructure. Rather than going for a lot of high initial capital expenditure in smart city projects, incremental frugal innovation utilizing the existing infrastructure is promoted, thereby reducing overall cost of the smart city project.

⁷³ https://www.orfonline.org/wp-content/uploads/2021/08/ORF_SpecialReport_155_SmartCitiesMission.pdf

⁷⁴ <https://eol.smartcities.gov.in/home>

⁷⁵ <https://www.mygov.in/mygov-survey/swachh-survekshan-2022/>

⁷⁶ <https://smartnet.niua.org/content/971e8575-bb74-4622-af6f-d6682ef00212#:~:text=The%20Bureau%20of%20Indian%20Standards,digital%20infrastructure%20across%20smart%20cities.>

⁷⁷ <https://tec.gov.in/onem2m>

⁷⁸ https://www.tec.gov.in/pdf/M2M/TR_IoT%20ICT%20Standards%20for%20Smart%20Cities.pdf

- There is much emphasis on **climate-smart cities in India**, and a framework for climate-smart cities is being developed. It is mandated for each smart city that at least 10% of energy should be from renewables so that India can achieve and meet climate-neutrality by 2050.

3.3 Weaknesses and Challenges

Here below are some of the weaknesses and challenges in the smart cities sector in India:

- **Financing of smart cities and collaborations:** financing and flow of funds complicated by delayed disbursement of funds and a lack of coordination between states and cities, are the two biggest challenges when it comes to the smart city. The total investment approved under the smart city plans for 100 cities has gone up to EUR 25 billion⁷⁹. However, analysis of the financial data reveals that the central government, as well as most of the states and local governments, are finding it difficult to mobilize funds, transfer them to SPVs, and use them efficiently⁸⁰. According to the MoHUA, the Central Government of India has released EUR 4 billion to 100 smart cities, but the state matching share is only EUR 3 billion. There is limited collaboration with private players and hesitance by government officials to pursue the PPP mode when implementing new technologies for smart cities.
- **More government coordination is needed:** there is a lack of coordination among the three-tier governance. There needs to be more transparent coordination between the centre, state, and local bodies to ensure the proper development of smart cities projects.
- **Project selection:** most projects funded under the SCM did not fit the international definitions of what should be considered as “smart” or “sustainable”. For example, nearly 40% of the transportation budget under the SCM has gone to roads and parking lots, with only 2% dedicated to buses and 13% dedicated to non-motorized transportation⁸¹. The challenge here is that the SCM projects did not fit the international definition as mentioned. Internationally a smart city project has different, more specific smart city interventions. But India has used the budget for traditional projects.
- **Access to advanced technologies:** many of the available international technologies are not available on the Government e-Market (GeM)⁸² portal (the national public procurement portal which empowers small traders and manufacturers of India), reducing their visibility.
- **Demonstration projects in India:** most advanced international technologies fail to work in the Indian context due to the absence of proof of concepts. An example is provided by SMART bins and other advanced waste management machines.
- **Availability of a master plan and a multi-sectoral approach:** most cities in India do not have master and development plans. The lack of a master plan creates many issues in project selection and implementation, as master plans provide a complete and overarching guideline for city development. The master plan approach is barely linked to any financial and operating strategy and, in many cases, has been used as a regulatory tool instead of a blueprint for developing dynamic smart cities. There is an urgent need for a multi-sectoral approach to spatial planning as sectoral schemes are executed by different government departments and are often not linked with each other. This is certainly not possible without adequate technical know-how and planning capacities at local levels. This further necessitates a stronger urban planning ecosystem in the country⁸³.
- **Need for capacity building:** people/authorities have limited understanding and know-how about the diverse technologies which have all been deployed and used in different smart city projects; this will

⁷⁹ <https://economictimes.indiatimes.com/news/economy/infrastructure/smart-city-rs-2-05-lakh-crore-projects-proposed-in-100-cities-significant-progress-made-says-survey/articleshow/70073619.cms>

⁸⁰ https://www.orfonline.org/wp-content/uploads/2021/08/ORF_SpecialReport_155_SmartCitiesMission.pdf

⁸¹ https://csd.columbia.edu/sites/default/files/content/docs/ICT%20India/Papers/ICT_India_Working_Paper_62.pdf

⁸² <https://gem.gov.in/>

⁸³ <https://www.niti.gov.in/sites/default/files/2021-09/UrbanPlanningCapacity-in-India-16092021.pdf>

reduce the utilization of technology, and over time, the technology will become redundant and obsolete. Smaller states in India have issued fewer tenders and experienced a lower project completion rate than larger states. SPVs set up in these states to implement the mission are not functioning well due to inadequate managerial, technical, and financial capabilities. Deficiencies were observed in data handling and its analysis, levels of digitalisation, fund mobilization, release, and utilization⁸⁴.

- **Other government missions induced challenges:** most of the budget and funding for solid waste management in India is sanctioned to the flagship program, Swachh Bharat Mission (Clean India Mission). This is a national battle started by the Government of India, which covers 4,041 urban areas and towns, to clean the lanes and streets and realize the resolution of garbage-free cities. This limits the smart cities when it comes to undertaking projects in the waste sector.
- **Policies and frameworks for data sharing:** Indian policies are not yet favourable for driving data sharing and openness to combine data from different sources. Single vendors for water/waste management in smart cities also restrict the use of data in other places and some of the collected data is not of high quality. There is no proper framework for the development of robust digital infrastructure which could facilitate the adoption of emerging technology areas such as 5G, IoT, AI, machine learning, drones, robotics, additive manufacturing, photonics, nano-based devices, etc., and their applications in areas such as cyber security, smart cities, and automation, with special focus on solving real-life problems.
- **Cybersecurity infrastructure:** smart cities rely on sensors and network-connected devices and systems that generate large volumes of data, which are vulnerable to hacking by cybercriminals who can steal confidential data, shut down access to essential resources, and gain illegal access to security cameras. Indian SMC projects need to invest more in developing cybersecurity technology and infrastructure. Cloud-based data storage and collection require a robust data security system to protect the data across the region at local and central levels.

4. Conclusion: Opportunities for Business, Investment and Collaboration

The European Union is an important partner for India enabling it to foster the exchange of experience and knowledge, and the availability and implementation of policies, practices and cost-effective and affordable technological solutions for smart and sustainable urban development. At the 15th summit between India and the European Union held on 15 July 2020, they endorsed an “EU-India Strategic Partnership: A Roadmap to 2025”. As a part of the second EU-India Joint Working Group, a Joint Action Plan 2021-22 was signed, which includes several initiatives to strengthen cooperation in the area of smart and sustainable development. The Joint Action Plan includes actions on⁸⁵:

- demographic change and competitiveness, environmental sustainability, disaster risk reduction and climate change, regional innovation and smart specialization policies and practices promoting smart and sustainable cities,
- promoting the involvement of European businesses and investments in sustainable urbanization,
- promoting climate action and disaster risk reduction in cities,
- developing effective solid waste management & treatment – promoting the circular economy,
- developing effective water supply & sewage systems,
- sustainable urban mobility.

⁸⁴ https://www.orfonline.org/wp-content/uploads/2021/08/ORF_SpecialReport_155_SmartCitiesMission.pdf

⁸⁵ https://ec.europa.eu/regional_policy/en/policy/cooperation/international/india/

Given the strengths and gaps in the EU and India, there is an opportunity to set up a collaborative EU-India smart city network and platform bringing together the 100+ EU and Indian cities that are implementing smart city projects. For practical purposes, the platform can start with 20 cities each from the EU and India which can be selected for networking, best practice exchange, and site visits. As a part of this platform, EU and Indian smart city technology companies and solution providers from the projects in selected cities can also be invited to network and share about their solution and experience, and express interest to do business in India and the EU respectively.

- The EU and its Member States can initiate education and capacity-building programs in India based on the experience of EU tech companies and cities.
- There is also an opportunity for EU-India smart city tech start-ups to start networking to facilitate business partnerships, co-creation, market access and collaboration. Given that the EU and India have very active start-up ecosystems focused on the smart cities' domain, the EU-India start-up platform for smart cities can open doors to access technology, exchange knowledge and expertise, business and investment for both regions.
- European organizations could collaborate and invest in setting up living labs, and exchange best practices with the Indian smart cities.
- In this manner, public and private sector leaders from the EU and India can learn about projects, processes and technologies, and companies can do business and invest in India and the EU, respectively.
- India has strong digital skills and talent, and Europe has climate tech skills and technologies – a great combination to leverage and work together to share strengths and gaps – where the gaps become the business opportunity and platform for collaboration and investment.
- Innovation, digitalization, and the climate – three significant pillars for the sustainable economic growth of the EU and India – come together when we talk about smart cities. This can be a collective deliverable for the EU and India to the world.

