



# Implementing ITU-T International Standards to Shape Smart Sustainable Cities: The Case of Moscow



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This case study is intended for informational purposes only. The results and interim findings presented in this case study are based on the U4SSC KPIs contained in the collection methodology, which are based in Recommendation ITU-T Y.4903/L.1603 on Key performance indicators for smart sustainable cities to assess the achievement of sustainable development goals.

The revision of the KPIs may alter their scope and definition, as well as the required data-collection process. Therefore, readers are cautioned that the KPIs presented in this case study may not necessarily be entirely compatible with the subsequent KPIs published by ITU-T after the revision process.

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## Foreword

In just seven years, starting in 2011, Moscow, a city with a history spanning nearly a thousand years, has undergone a tremendous transformation as it heads towards its tech-savvy future. Today we are proud to introduce Moscow Smart City with disruptive technologies: blockchain in an e-voting system, widespread Wi-Fi network, public online schools, AI-based healthcare and many more.

As a city with more than 12 million residents, which is equivalent to the populations of Norway and Switzerland combined, Moscow must adopt the concept of Smart City to ensure the well-being of Muscovites, and to allow its administration and businesses to work more efficiently. This is why one of our fundamental pillars is to establish a constant dialogue with our citizens, so establishing the city-as-a-service concept.



Indeed, Moscow has become one of the world leaders in citizen engagement. This has been made possible because the city has infused its more than 220 public e-services within digital city management platforms like MOS RU, Crowd Mos, and blockchain-based Active Citizen to name but a few. These are used by Muscovites to suggest ideas, report local problems, initiate crowd sourcing and for voting on local matters.

The city of Moscow has reached nearly 100 per cent 4G and high-speed internet coverage. It is the second-largest Wi-Fi-covered city in the world. Such a high level of connectivity gives Muscovites unlimited access to new knowledge and data that can drive innovation and result in a more favorable economic ambience.

One of the best aspects of our actions and achievements is that they are observable and tangible. For instance, 12 500 new trees have appeared on the streets, greatly improving the livability of the city. At the same time, the number of pedestrians has been increased by 70 per cent, indicating that the streets and sidewalks in Moscow have been made more pedestrian-friendly. Seventy-five per cent of residents have also gone online to express their satisfaction in our work.

We do believe that the U4SSC's KPIs for Smart Sustainable Cities will support and foster further ICT adoption for Moscow and for other smart cities worldwide.

It is an honour for us to be a testing bed for evaluating ICT-based solutions using the U4SSC KPIs, which is a sign of respect, trust and recognition from the international community in general, and from the ITU in particular. We recognize the significance of adopting standards. They are effective tools for gaining new perspectives and the possibility of independent estimation.

I would, therefore, like to express my appreciation to our colleagues from abroad and to the professional and committed team at ITU in particular for their hard work in advancing global smart cities development.

Artem Ermolaev  
CIO of Moscow (2010-2018)  
Head of the Department of Information Technologies



Moscow is home to more than 12 million people. It is the largest city on the European continent. Moscow's architecture is a remarkable blend of old and new, telling the story of its rich history. The city also hosts a sprawling urban forest, with 40 per cent of Moscow's surface covered in greenery.

Moscow's smart city journey began in 2011 and offers a strong reminder that no two cities are the same. The unique priorities of Moscow's smart city strategy reflect the unique set of challenges introduced by the size of Moscow and its population.

The '[United for Smart Sustainable Cities \(U4SSC\) initiative](#)' advocates for public policy to ensure that information and communication technologies (ICTs) – and ICT standards in particular – play a definitive role in the transition to smart sustainable cities.



U4SSC is coordinated by ITU and UNECE and supported by 14 other United Nations bodies. The collaboration driven by U4SSC has led over 50 cities to adopt *Key Performance Indicators for Smart Sustainable Cities* based on ITU standards.

ITU-T Study Group 20 leads the development of ITU standards for the Internet of Things and smart cities. These standards assist in optimizing the application of ICTs within smart cities, in addition supporting efficient data processing and management.

U4SSC promotes the adoption of international standards and the reporting of associated experiences. This information exchange is enabled by the U4SSC Key Performance Indicators. These indicators offer a common format to report the progress of smart city strategies. They also enable cities to measure their progress against the United Nations Sustainable Development Goals.

We see prime examples in this Moscow case study as well as prior case studies of Dubai and Singapore. These case studies share empirical knowledge of great value to other cities around the world. This reporting also solicits feedback that helps cities to refine their smart city strategies.

I would like to applaud Moscow for its contribution to international collaboration in support of smart sustainable cities. This Moscow case study is certain to provide a valuable reference point to other cities around the world, particularly in the CIS region.

Dr Chaesub Lee  
Director, ITU Telecommunication Standardization Bureau



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## Executive summary

The International Telecommunication Union (ITU), the United Nations (UN) specialized agency for information and communication technologies (ICTs) and an international standard developing organization, has developed a set of International Standards (ITU-T Recommendations) on key performance indicators (KPIs) for smart sustainable cities (SSC) to assist cities in becoming smarter and more sustainable and provide cities with a tool for self-assessment.

In 2018, Moscow initiated a partnership with ITU to implement the United for Smart Sustainable Cities (U4SSC) KPIs on smart sustainable cities. These KPIs are based on Recommendation ITU-T Y.4903/L.1603 on “Key performance indicators for smart sustainable cities to assess the achievement of sustainable development goals”. The KPIs are categorized into three key dimensions: Economy, Environment, and Society and Culture. These KPIs are specifically designed to assess compliance with existing international city KPIs, to assist in measuring Moscow’s progress towards its Smart Moscow 2030 strategy and to help cities achieve the UN Sustainable Development Goals (SDGs).

This case study documents the key findings arising from the first year of the close working relationship between Moscow and ITU. It also highlights the activities carried out by different entities to support Moscow’s various Smart City initiatives.

Section 1 delves into the history of the ITU in assisting Smart Sustainable City projects and the importance of standardization in fostering Smart Sustainable City transitions. This section also highlights the important role of the U4SSC in driving the transition of Smart Sustainable Cities worldwide by sharing technical knowledge and preparing appropriate guidelines.

Section 2 describes Moscow’s Smart City transitions and traces the city’s journey since adopting the Information City strategy in 2011. This section also presents the details of Moscow’s upcoming Smart City strategy: Smart Moscow 2030.

Section 3 highlights the scope of the U4SSC KPIs for the SSC project in Moscow and underscores the three main phases of implementing the KPIs. The KPIs are the primary tool **to measure Moscow’s efforts in becoming smarter and more sustainable**.

Section 4 explores and links the various Smart City activities adopted by Moscow with the three dimensions of measuring a city’s smartness and sustainability, and provides a deeper understanding of Moscow’s efforts in each of these areas.

Section 5 highlights several best practices for aspiring smart cities based on Moscow’s experience in implementing the U4SSC KPIs. This section also offers suggestions for Moscow to strengthen its position as a growing smart city and to improve the applicability of the KPIs to the city’s specific case.

One of the goals of this project was to improve the feasibility and applicability of the KPIs. Moscow has provided input to the existing KPI definitions and also practical solutions to improve the data collection process. The key findings of this working relationship will contribute to the development of the first “ITU Global Smart Sustainable Cities Index”.

## Common terms

µg / m <sup>3</sup>	Micrograms per cubic metre
3G	Third generation
4G	Fourth generation
5G	Fifth generation
AI	Artificial intelligence
AQI	Air Quality Index
CCTV	Closed-circuit television
CIS	Commonwealth of Independent States
DIT	Department of Information Technology
EMF	Electromagnetic field
EV	Electric vehicles
GDP	Gross domestic product
GHGs	Greenhouse gases
GJ	Gigajoule
GLONASS	Global Navigation Satellite System
GPS	Global Positioning System
ICTs	Information and communication technologies
IoT	Internet of things
IT	Information Technology
ITU	International Telecommunication Union
ITU-T	ITU Telecommunication Standardization Sector
Km	Kilometres
KPIs	Key performance indicators
kWh	Kilowatt hours
L	Litres
m <sup>2</sup>	Square metres
m2m	Machine to machine
MB	Megabytes
MCC	Moscow Central Circle
MKAD	<i>Moskovskaya Kol'tsevaya Avtomobil'naya Doroga</i> (Moscow Automobile Ring Road)
NO <sub>2</sub>	Nitrogen dioxide
O <sub>3</sub>	Ozone
OECD	Organisation for Economic Co-operation and Development
PHEV	Plug-in hybrid electric vehicles
PM	Particulate matter
PwC	PricewaterhouseCoopers
R&D	Research and development
RFP	Request for Proposal



SDGs	Sustainable Development Goals
SMEs	Small and medium enterprises
SO <sub>2</sub>	Sulphur dioxide
SSC	Smart sustainable cities
U4SSC	United for Smart Sustainable Cities
UMIAS	Unified Medical Information Analysis System
UN	United Nations
UNECE	United Nations Economic Commission for Europe
USB	Universal Serial Bus
VR	Virtual reality
WeGo	World e-Governments Organization of Cities and Local Governments
WHO	World Health Organization
Wi-Fi	Wireless Fidelity

# SMART CITY



SMART MEDICINE



CONNECTED CAR



SMART RETAIL



SMART HOME



SMART ENERGY



SMART AGRICULTURE



SMART INDUSTRY



INTERNET OF THINGS



## 1. ITU and Smart Sustainable Cities

### 1.1. Introduction to ITU's work on smart sustainable cities (SSC)

The International Telecommunication Union (ITU) is the United Nations specialized agency for information and communication technologies (ICTs). ITU is committed to supporting cities around the world and their evolution to become smart and sustainable. In line with its role as an international standard developer, ITU has developed frameworks for public policies, international standards (ITU-T Recommendations) and guidelines that identify the role of ICTs in smart sustainable cities.

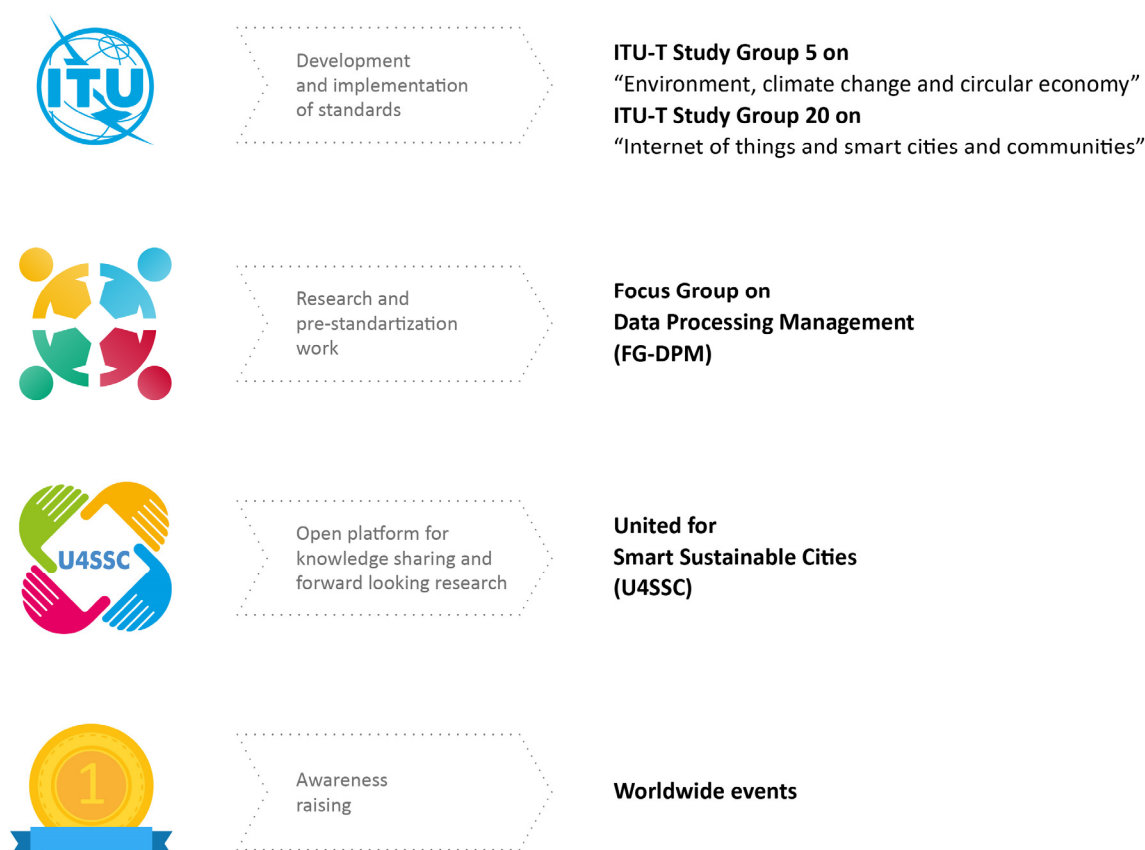
In October 2015, ITU and the United Nations Economic Commission for Europe (UNECE) agreed on the following definition for smart sustainable cities:

*“A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects.”*

ITU plays a significant role in providing a consolidated platform for discussions on policies, strategies and standards related to Smart City development. This responds directly to one of the greatest challenges of developing Smart City initiatives today, which is the fragmentation of agencies and stakeholders in carrying out Smart City activities with the lack of global standards as guidance.

With input into its activities from leading cities and Smart City experts, ITU has strengthened its position as a central player in smart sustainable city development around the globe. Its activities are summarized in Figure 1.





**Figure 1: ITU's comprehensive role in Smart Sustainable research, development and implementation<sup>1</sup>**

ITU-T, the standardization sector of ITU, has developed a set of key performance indicators (KPIs) to assist cities in integrating ICT services into their existing urban operations. These indicators are contained in Recommendation ITU-T Y.4903/L.1603 on "Key performance indicators for smart sustainable cities to assess the achievement of sustainable development goals". The main purpose of these KPIs is to provide cities with a credible monitoring system for their Smart City transitions.

These ITU-T Recommendations were approved as international standards by ITU-T Study Group 5 on Environment, Climate Change and Circular Economy in 2016.<sup>2</sup> Subsequently, the KPIs contained in those Recommendations formed the basis of the U4SSC KPIs for SSC. For more information on the U4SSC initiative, see Box 1.

<sup>1</sup> Úbeda (2018).

<sup>2</sup> ITU-T Recommendations are international standards developed by ITU-T, the standards development wing of the International Telecommunication Union.

The U4SSC KPIs for Smart Sustainable Cities<sup>3</sup> are sorted into three key dimensions: 1) Economy, 2) Environment, and 3) Society and Culture. Each dimension further encompasses different sub-dimensions including:<sup>4</sup>

1. Information and Communication Technologies (ICTs)
2. Productivity
3. Infrastructure
4. Environment
5. Energy
6. Education, Health and Culture
7. Safety, Housing and Social Inclusion

Following closely on the heels of Dubai and Singapore, Moscow – along with Valencia, Bizerte, Kairouan, Pully, Manizales, and many others – has initiated a unique working relationship with ITU to test and verify the U4SSC KPIs for Smart Sustainable Cities. Accordingly, the U4SSC KPIs for Smart Sustainable Cities are being used to assist Moscow and other participating cities in analysing ICT's role and contribution in making cities smarter and more sustainable.

These KPIs are effective tools for self-assessments of current and future partner cities' "smartness" and "sustainability" schemes. The U4SSC KPIs for Smart Sustainable Cities are also intended to be used for monitoring a city's ongoing performance with respect to its Smart City goals and the Sustainable Development Goals (SDGs). Currently, more than 50 cities are implementing these KPIs.

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<sup>3</sup> <https://www.itu.int/en/publications/Documents/tsb/2017-U4SSC-Collection-Methodology/index.html>

<sup>4</sup> These sub-dimensions (categories) have been established based on core themes that organize commonalities between the indicators.

### United for Smart Sustainable Cities

On 18 May 2016, ITU – together with UNECE – established the [United for Smart Sustainable Cities \(U4SSC\) Initiative](#), which serves as the international platform for sharing knowledge and developing best practices linked to smart sustainable cities. The U4SSC is now a United Nations initiative coordinated by ITU and UNECE and supported by 14 other United Nations agencies and programmes.

This global platform was created in response to United Nations Sustainable Development Goal (SDG) 11: “Make cities and human settlements inclusive, safe, resilient, and sustainable.” Unlike other smart city platforms, this initiative is open to all interested parties who wish to contribute to its work.

Since its inception, U4SSC has been endorsing the adoption of public policies to encourage the use of information and communication technologies in establishing smart sustainable cities.

This initiative completed its first phase in April 2017 with the development of three publications on [Connecting cities and communities with the Sustainable Development Goals](#); [Enhancing innovation and participation in smart sustainable cities](#); and [Implementing SDG11 by connecting sustainability policies and urban planning practices through ICTs](#). Each of these reports was prepared in line with the Sustainable Development Goals (SDGs). More than 100 participants contributed to these U4SSC publications.

The U4SSC is currently working on the following deliverables:

- Guidelines on tools and mechanisms to finance SSC projects
- Guidelines on strategies for circular cities
- City science application framework
- Guiding principles for artificial intelligence in cities
- Blockchain 4 cities
- Thematic Group on "The Impact of Frontier Technologies in Cities"
  - The impact of Sensing Technologies and IoT in Cities
  - The impact of Artificial Intelligence and Cognitive Computing in Cities
  - The impact of Data Processing and Computation in Cities

### Box 1: United for Smart Sustainable Cities initiative

Moscow’s experience in piloting the U4SSC KPIs for SSC will help to refine and improve these KPIs. Data collected for these KPIs will also be used to develop the Global Smart Sustainable Cities Index, which is a tool intended to display the effectiveness of a city’s SSC initiatives and its progress in reaching the SDGs in comparison to other cities. For more information on the Global Smart Sustainable Index, see Box 2 below.



### Global Smart Sustainable Cities Index

ITU's Global Smart Sustainable Cities (SSC) Index is currently being developed under a cooperation agreement between the ITU and Smart Dubai. The ITU SSC Index is based on the Key Performance Indicators (KPIs) for Smart Sustainable Cities (SSC) that were developed with input from 16 United Nations (UN) agencies, Dubai and 50 other cities under the framework of the U4SSC Initiative.

Input is also being gathered from other external researchers and scientists from universities, institutes and think tanks spanning different fields of research, e.g. political and social science, economics, institutional economics, sociology, mathematics, statistics, computer science, philosophy, as well as from city planners, architects and environmentalists, and others.

The ITU SSC Index came about as a result of the need to:

- measure progress;
- make transparent the different levels of economic integration, geographic location and sizes of cities;
- evaluate and integrate different levels of quantitative and qualitative data;
- make these data comparable and visible with state-of-the-art scientific methods;
- transform/translate scientific outcomes into easily-understandable graphics and numbers; and
- make outcomes/results public for users (e.g. citizens and governments).

Furthermore, the ITU SSC Index is expected to fulfil certain outcomes. Specifically, the ITU SSC Index will:

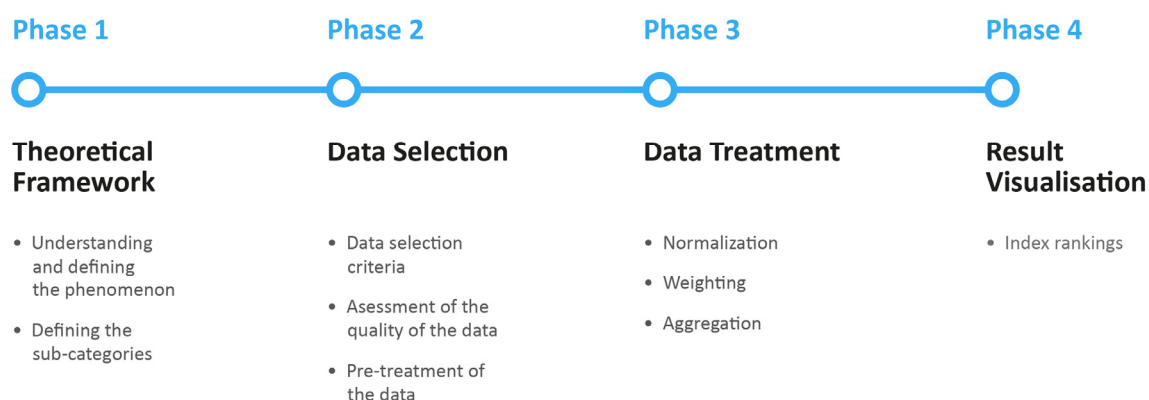
- set new standards to compare cities;
- be the first international set of coherent metrics;
- uniquely coordinate data input from all international resources (e.g. UN Statistical Division, World Bank, OECD) and the evaluated KPI city data utilizing state of the art scientific methods;
- benchmark the cities' contribution to sustainability and smartness, as well as their ongoing efforts towards implementing the United Nations (UN) Sustainable Development Goals (SDGs);
- be a highly useful tool for any city to improve, advance and further develop its performance related to society, economy and the environment; and
- allow cities to learn from each other in a transparent manner.

### Box 2: ITU's Global Smart Sustainable Cities Index<sup>5</sup>

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<sup>5</sup> Kolm (2018)

Additionally, Figure 2 below provides an overview of the general phases planned for the development of the ITU SSC Index.



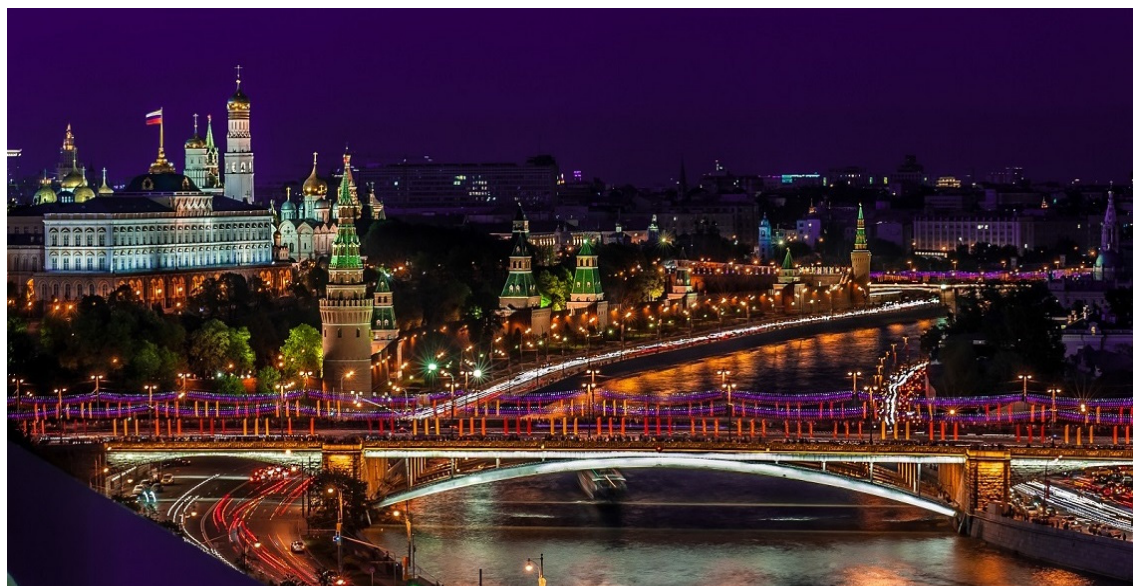
**Figure 2: Planned phases for construction of the ITU SSC Index<sup>6</sup>**

Moscow's long-term commitment to its technological and Smart City initiatives makes it ideal for the implementation of the U4SSC KPIs on Smart Sustainable Cities.

With the active support of ITU, the first year of the project in Moscow has ended with tremendous success. The results and key findings from the first year are presented in this case study.

## 2. Smart and sustainable Moscow

### 2.1. Introduction to a smart and sustainable Moscow



**Figure 3: City of Moscow at nighttime<sup>7</sup>**

<sup>6</sup> Kolm (2018)

<sup>7</sup> <https://www.mos.ru/en/city/about/>

Moscow, one of Russia's three federal cities, is the country's capital and the largest city by population and land area. The historic city dates back to the first half of the twelfth century. The city's urban infrastructure has evolved over and over again, in order to be responsive to its citizens' needs. Today, the city of Moscow continues to be Russia's political, economic, financial, cultural, architectural and scientific hub.

Moscow is one of the largest economies among global metropolitan areas – the tenth largest in 2017 based on gross domestic product (GDP). It is also one of more than 30 megacities around the globe – a megacity defined by the United Nations (UN) as a metropolitan area with a total population of more than 10 million people. Research into megacities has shown that, while megacities are at great risk of being vulnerable to the impacts of climate and social change due to rapid urbanization,<sup>8</sup> they also have the best chances in fostering a sustainable future. Megacities are the engine of a country's economic growth and social development and, in many cases, the drivers of broader regional urbanization.<sup>9</sup> Megacities attract the most talented individuals and lay the foundation for direct inward investment as they are often at the centre of a cluster of smaller cities. This creates network effects that foster broader regional economic growth and productivity.<sup>10</sup> The news in recent years indicates that this holds true for Moscow.<sup>11, 12</sup>

At the sixth annual Moscow Urban Forum in early July 2017,<sup>13</sup> Moscow's Mayor, Mr Sergey Sobyenin, read an address from the Russian President, H.E. Mr. Vladimir Putin, that stated:<sup>14</sup>

*"In the current global economy, the competitiveness of a country's megacities determines the competitiveness of the country as a whole, and thus we are paying close attention to the quality of living in Moscow, all the items of infrastructure, traffic flow, energy saving, and protection of cultural heritage."*

Given its vital importance to Russia and in order to respond to the challenges set by rapid urbanization, over the last few years Moscow has undergone major revitalizations in its urban infrastructures and in the way government services are delivered. One result of this has been its rapid and successful evolution into a global European smart and sustainable city.

In the 2018 United Nations (UN) E-Government survey, Moscow is ranked number one among 40 cities in delivering digital services, followed by Cape Town and Tallinn, then by London and

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<sup>8</sup> Urban Development Overview | World Bank

<sup>9</sup> Kötter, Friesecke (2009)

<sup>10</sup> Dobbs, et al. (2011)

<sup>11</sup> <https://www.mos.ru/en/news/item/36036073/>

<sup>12</sup> <https://www.mos.ru/en/news/item/36584073/>

<sup>13</sup> The theme of the 2017 Moscow Urban Forum was "Age of Agglomerations. Rethinking the World Map". The theme in July 2018 will be "Megacity of the Future. New Space for Living".

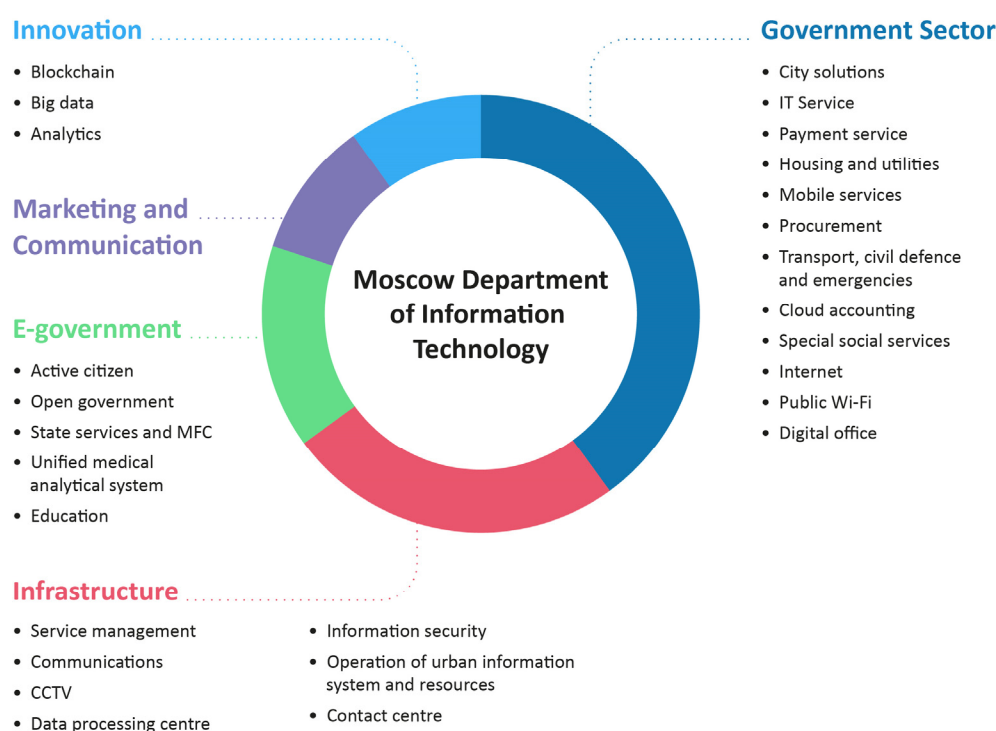
<sup>14</sup> Stivers (2017)

Paris.<sup>15</sup> In July 2017, PricewaterhouseCoopers (PwC) included Moscow as one of the top five “megapolises” that are ready for innovation. In June 2017, the Russian capital received a special mention from the World e-Governments Organization of Cities and Local Governments (WeGO) in the category of e-government services, and in February 2017, the Intelligent Community Forum ranked Moscow among the top seven finalists in the most intelligent city contest.<sup>16</sup>

## 2.2. Moscow’s smart and sustainable strategy

Moscow’s path to becoming a leading smart sustainable city started in 2011 after its current Mayor, Sergey Sobyanin, took office. The overall city development strategy underwent a number of major changes under Mayor Sobyanin. One of these changes was the digitalization of all city functions that would see most of the public services being delivered via digital platforms.

To achieve this, the Moscow City Government has centralized the city’s technical and digital development within one department, the Department of Information Technology (IT), more commonly referred to as the IT Department (see Figure 4). This department was authorized to improve IT procurement proactively across all areas in Moscow, with the mandate to establish cost-efficient IT procurement practices within the city. The IT Department was also tasked with ensuring the interoperability of various city systems, and leveraging the potential of big data in delivering insights that would drive decision making.<sup>17</sup>



**Figure 4: Structure of the Moscow Department of Information Technology**

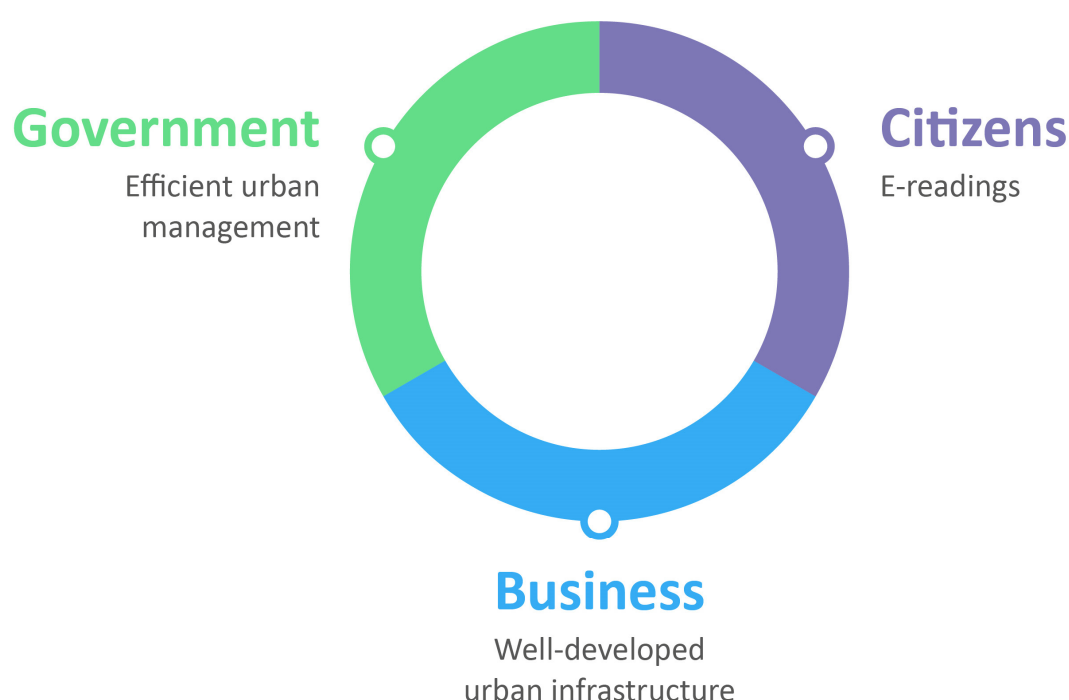
<sup>15</sup> <https://www.smartcitiesworld.net/news/news/united-nations-ranks-moscow-top-for-e-government-services-3174>

<sup>16</sup> <https://www.mos.ru/en/city/projects/smartcity/>

<sup>17</sup> Kuznetsov (2017)

## Information City

In accordance with the foregoing mandate, a Smart City strategy called “Information City” was implemented in 2011 until the end of 2018.<sup>18</sup> This strategy has taken a tri-lateral stakeholder approach in which the interaction between government, business and citizens was the focus when formulating and implementing Smart City solutions. The goals of Information City were to establish electronic services for citizens and businesses, to deliver smart municipal management services that would galvanise the city’s advertising and media sector, and to modernise its telecommunications infrastructure.<sup>19</sup> The city has invested more than 600 million USD every year since 2011 in achieving these objectives – an investment which is made possible because the city is home to many of the country’s top businesses and generates significant revenue from taxes and tourism.<sup>20</sup> The strategy thus capitalized successfully on its synergistic tri-lateral stakeholder focus, as shown in Figure 5.



**Figure 5: Moscow’s smart sustainability stakeholders**

Major Smart City solutions were designed within the Information City framework. Moscow has invested significantly in ICT infrastructure development, machine-to-machine (m2m) projects, e-healthcare, e-education, public services delivery, citizen engagement, and other key areas of life via the tri-lateral stakeholder approach among the three main stakeholder groups.

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<sup>18</sup> Athar (2018)

<sup>19</sup> Simpson (2017)

<sup>20</sup> Martinidis (2017)

## The Smart City Lab

To further the development and integration of new technologies, a Smart City Lab was created inside the IT Department in 2016. The Smart City Lab is a think tank of urban innovations. It is responsible for sourcing prospective projects, technologies and companies that would meet Moscow's biggest challenges in making the city more liveable.<sup>21</sup> The Smart City Lab also develops and tests tools that would improve the efficiency of the existing infrastructures. It serves as a conduit for smart and sustainable city idea generation within Moscow's IT Department and engages in a wide-array of research, scanning, analysis and benchmarking activities. The Lab also collaborates with different private, public and academic partners to gather and disseminate information on best practices and the latest developments in smart sustainable cities. The Smart City Lab's comprehensive set of activities aids the IT Department and City Government in identifying, developing and implementing policies and solutions for a smart and sustainable Moscow. The Lab's workflow is illustrated in Figure 6.

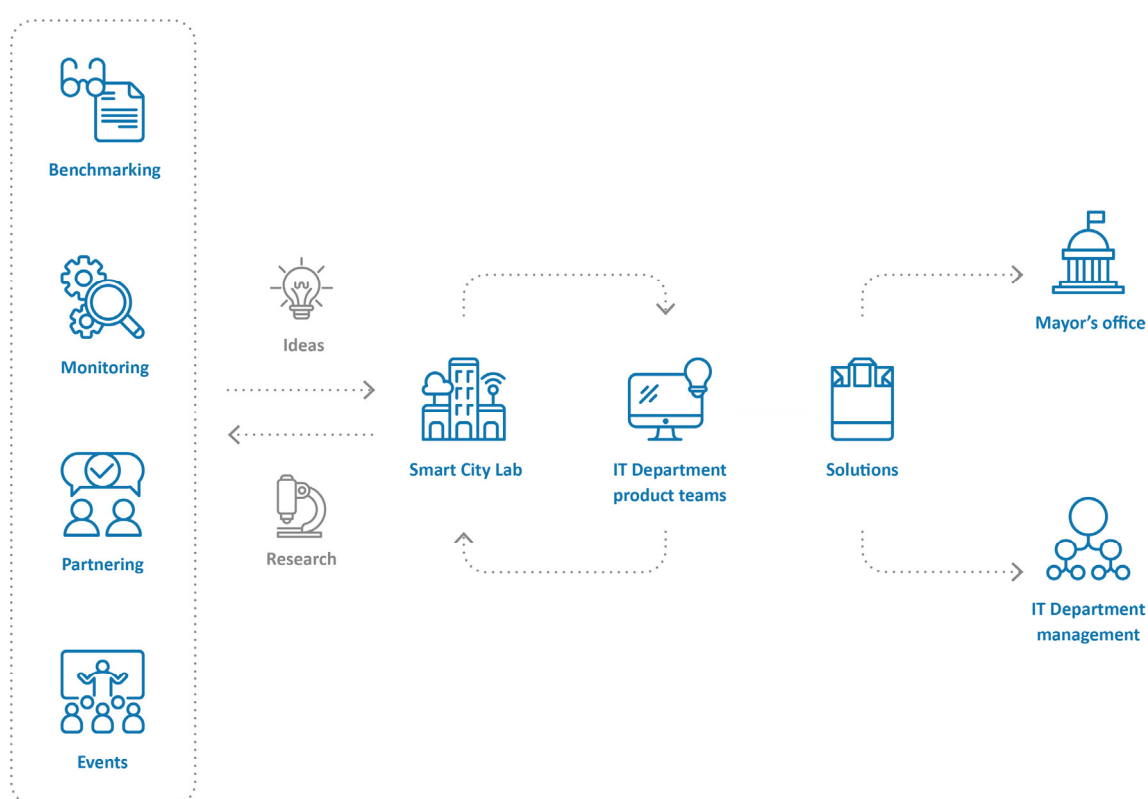


Figure 6: Moscow Smart City Lab's scheme of workflows<sup>22</sup>

<sup>21</sup> Smart City Lab: Overview | LinkedIn. <https://www.linkedin.com/company/smartcitylab/>

<sup>22</sup> Received as part of Smart City Lab's answers to ITU's pre- case study development Preliminary Questions.

## Smart Moscow 2030

The IT-department is currently working to support the new “Smart Moscow 2030” strategy that is under development and will replace the Information City strategy after 2018. This new strategy will consolidate Moscow’s current efforts in making the city smarter and it will become the blueprint for creating a digital future for Muscovites. The strategy starts with a new and updated vision for a Smart Moscow (Box 3). It will define new goals that will see the implementation of digital technologies in all aspects of city planning, so benefitting citizens and improving their quality of life (Box 4).

### Smart Moscow 2030: Vision

Use digital technologies to:

- make citizens happier, healthier and more educated, and to boost their well-being;
- make the city safer, greener, more environment-friendly, comfortable for life, sustainable, and joyful;
- create a favorable environment for the business, entrepreneurship and scientific communities that would facilitate well-being, innovations and the transformation of the city into a live laboratory for growth and development
- unite people, in order to enhance living standards and city governance efficiency;
- facilitate the consolidation of society;
- ensure an active life for elderly residents.

### Box 3: Vision of the Smart Moscow 2030 strategy<sup>23</sup>

### Smart Moscow 2030: Goals

- To use digital technologies for sustainable enhancement of citizens’ living standards and favorable conditions for entrepreneurship and other activities
- To implement centralised, comprehensive and transparent city governance on the basis of Big Data and Artificial intelligence technologies.
- To boost the efficiency of government expenses also through implementing public and private partnership in information and digital technologies and communications.

### Box 4: Goals of the Smart Moscow 2030 strategy

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<sup>23</sup> [https://2030.mos.ru/netcat\\_files/userfiles/documents\\_2030/strategy\\_tezis\\_en.pdf](https://2030.mos.ru/netcat_files/userfiles/documents_2030/strategy_tezis_en.pdf)



As part of its cohesive view of smartness and sustainability, the new strategy will aim to efficiently synchronize all the various facets of life within Moscow, as shown in Figure 7.



**Figure 7: Smart Moscow 2030 strategy dimensions**

The Smart City 2030 strategy and its six dimensions were developed after discussions with the software development community in Moscow, as well as with communications providers and other entrepreneurs in the city's ICT industry. More than 20 000 experts, business operators and local executives took part in those discussions. To-date, close to 500 proposals have been submitted for the strategy.

Muscovites were also invited to share their ideas on the direction for digital development and the technology that is expected to be implemented in the city by 2030. The discussion took place on [crowd.mos.ru](https://crowd.mos.ru) until August 10, 2018.<sup>24</sup> In the words of Alexei Chukarin, Deputy Head of the Moscow Information Technology Department: "Such a high-level document is being discussed

<sup>24</sup> <https://www.mos.ru/en/news/item/43349073/>

with the business community and city residents for the first time. People-friendliness is the main principle of the Smart City project. People should take part in running and developing the city at every level.”<sup>25</sup>

### 3. Piloting the U4SSC KPIs for SSC: The case of Moscow

#### 3.1. Background

In 2018, Moscow began to work closely with ITU on piloting the feasibility of the U4SSC KPIs for Smart Sustainable Cities (SSC). Moscow is one of many cities around the world that is assessing the efficiency and sustainability of its urban services using these KPIs developed by the U4SSC.

As noted by Chaesub Lee, Director of the Telecommunication Standardization Bureau at ITU:

*Our world is very diverse, in language, culture, climate and levels of economic development. Cities face different urban-development challenges, with the result that the priorities of their smart city strategies will often differ significantly. The U4SSC Key Performance Indicators offer cities a tool for self-assessment. They enable cities to assess the degree to which their smart city strategies are achieving their objectives. They provide a common format to report the progress of strategies that may differ significantly. This Moscow case study will share valuable insight into how Moscow’s smart city strategy addresses the challenges unique to Moscow’s context.*

Similarly, Andrey Belozerov, Strategy and Innovations Advisor to the CIO of Moscow remarked:

*“The city of Moscow is developing at an exponential pace, which compels us to look for new tracking and estimation tools to measure the city’s sustainability. The project with ITU, especially the development this Case Study, is unique in that: it is a single publication that provides a 360-degree analysis of the evolution of the whole city while taking into consideration all the promising smart sustainable city projects in Moscow from different areas.”*

This project between Moscow and ITU seeks, in part, to test the applicability of these KPIs. Successfully implementing them will lay the foundation for identifying the standardised requirements of Smart Sustainable Cities. One of the most unique elements of the U4SSC KPIs on SSC is that not only do they measure the degree of effectiveness of a city’s smart solutions, they also illustrate a city’s progress in meeting the UN SDGs. These KPIs are capable of measuring a city’s smartness against the targets set-forth in the SDGs. The results then allow policymakers to make better and more informed decisions.

Similar to other reporting cities, Moscow relies on different government departments and authorities to collect the necessary data to report on the different KPIs. The Smart City Lab acted as the coordinating entity for this project and played a central role in collecting the required data and providing valuable feedback.

The following sections highlight the three phases of implementing the U4SSC KPIs for SSC in Moscow.

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<sup>25</sup> <https://www.mos.ru/en/news/item/43349073/>

### First Phase of the project

The first phase of the project involved the collection of data by various Moscow City Government agencies and related authorities. As indicated previously, the U4SSC KPIs for SSC are based on Recommendation ITU-T Y.4903/L.1603 - Key performance indicators for smart sustainable cities to assess the achievement of sustainable development goals.<sup>26</sup> Accordingly, these KPIs are categorized into the three dimensions: 1) Economy, 2) Environment, and 3) Society and Culture, with each dimension containing different sub-dimensions, as detailed in Table 1 below.

**Table 1: ITU's SSC dimensions and sub-dimensions<sup>27</sup>**

Dimension	Sub-Dimension	Description
Economy	<b>Information &amp; Communication Technologies</b>	<ul style="list-style-type: none"> <li>These KPIs aim to assess the availability and use of ICT infrastructure in cities to facilitate smart sustainable city services.</li> <li>Cities should demonstrate that they have secure and reliable ICT infrastructure, services, and customer-friendly services and devices.</li> <li>ICT networks and information platforms should contain effective mitigation of possible risks associated with the use of ICTs (e.g. electromagnetic fields, privacy issues and child online protection).</li> </ul>
	<b>Productivity</b>	<ul style="list-style-type: none"> <li>These KPIs aim to assess the use and impact of ICTs in the economic development of cities. They cover innovation, job creation, trade and productivity.</li> <li>These KPIs are also expected to play a pivotal role in assessing a city's adoption of ICTs to support socio-economic growth.</li> </ul>
	<b>Infrastructure</b>	<ul style="list-style-type: none"> <li>These KPIs aim to assess the impact of ICTs on city infrastructure, development and sustainability.</li> <li>Aspects evaluated by these KPIs include infrastructure for the provision of city services, such as water and waste management, energy, sewage, transport, road infrastructure and buildings.</li> </ul>

<sup>26</sup> Approved on October 7, 2016

<sup>27</sup> As categorized in the ITU-T Recommendations.

Dimension	Sub-Dimension	Description
Environment	Environment	<ul style="list-style-type: none"> <li>These KPIs aim to assess the use of ICTs in supporting urban environmental services and improving the overall environmental quality in cities.</li> </ul>
	Energy	<ul style="list-style-type: none"> <li>These KPIs aim to assess the use of renewable and sustainable sources of energy in a city, as well as its energy efficiency and energy reduction measures.</li> <li>The use of energy from renewable sources, along with efficient uses of energy, can lead to the longer-term sustainability of an urban area, provide for more independence of electricity supply, and lead to the reduction of GHG emissions related to electricity generation.</li> </ul>
Society & Culture	Education, Health and Culture	<ul style="list-style-type: none"> <li>These KPIs aim to assess the impact of ICTs to improve citizens' quality of life.</li> <li>They focus on areas such as education, health and city safety, among other aspects related to quality of life within the city.</li> </ul>
	Safety, Housing and Social Inclusion	<ul style="list-style-type: none"> <li>These KPIs aim to assess the impact of the use of ICTs to promote urban equity, citizen participation and to enhance social inclusiveness.</li> <li>They focus on qualities such as equity, governance, city openness and public participation.</li> </ul>

During the first phase of the project, ITU-T provided Moscow guidance on the use of the KPIs within the context of Smart Sustainable Cities. Following the receipt of the U4SSC KPIs, Moscow reviewed the KPIs to determine which departments, agencies and other entities would be responsible for collecting the necessary data and supporting documentation for each indicator. As mentioned previously, the IT Department's Smart City Lab coordinated this effort and reached out to other Moscow City Government departments, agencies and entities (e.g. Moscow's Department for Environmental Management and Protection, and its associated State Environmental Conservation Agency) to gather the required data for the indicators. Most data sources (approximately 97%) were able to provide current, real-time or primary data from the

period 2017-2018, while secondary data from 2016 and earlier constituted just over 3 per cent of all data collected.<sup>28, 29</sup>

The data collection process was coordinated with the departments, agencies and entities listed in Table 2.

**Table 2: Key entities involved in Moscow's Smart Sustainable Cities (SSC) project<sup>30</sup>**

Entity	Function
<b>Department of Finance</b>	This department prepares the budget of Moscow and organizes its execution, manages public debt, and engages in normative legal regulation of the budgetary processes.
<b>Department of Economic Policy and Development</b>	This department is responsible for preparing a stable tax base and improving tax administration. It is also responsible for increasing the efficiency of budget expenditures, enhancing the investment attractiveness of the capital, and ensuring the proper implementation of large-scale investment projects and import substitution programmes.
<b>Department of Trade and Services</b>	This department is responsible for trade, retail markets, and organizing weekend, regional and specialized fairs & festivals such as "Moscow Seasons". It also ensures food security and is in charge of the capital's agro-industrial complex, the development of agricultural policies, public catering, the production and turnover of alcohol and alcohol-containing products, consumer services for the population, and funeral and burial services.
<b>Department for the Development of New Territories</b>	This department is responsible for the implementation of city planning policies in the Troitsk and Novomoskovsk districts of Moscow. It is also responsible for the preparation of regulations related to territorial planning and urban zoning. The department coordinates and administers Moscow's Address Investment Programme.

<sup>28</sup> Received as part of Smart City Lab's answers to ITU's pre- case study development Preliminary Questions.

<sup>29</sup> For example, Moscow's entire traffic and transport network is managed by its Traffic Management Centre, under the auspice of the city's Department of Transport and Road Infrastructure Development. The high-tech current or real-time data-driven system of traffic flow analysis that it employs is augmented by GPS data in particularly dense and labyrinthine areas, such as 'old Moscow'. Information is gathered via the standard Global System for Mobile Communications (GSM) and used to identify redundant or needful traffic arrangements, as well as the provisioning of interchanges on the underground system and corresponding availability of bus services (Anderson, 2015). The data are also used to support and effect longer-term policy changes by the city government, as well as being used to report on the relevant U4SSC KPIs related to transport and mobility. See section 4.2 for more details.

<sup>30</sup> Received as part of Smart City Lab's answers to ITU's pre- case study development Preliminary Questions.

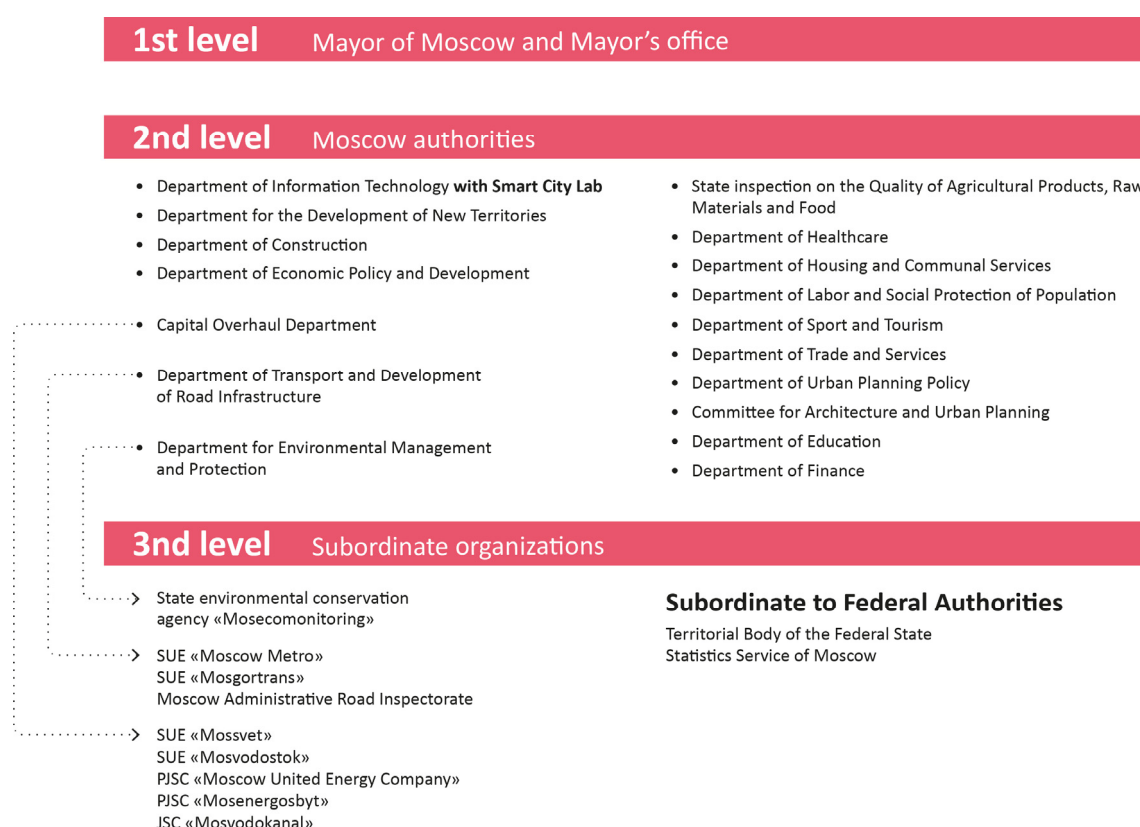
Entity	Function
<b>Department of Housing and Communal Services</b>	This department deals with housing and communal services, management of multi-apartment buildings, resource supply, water disposal, maintenance and repair of engineering facilities and communications.
<b>Department of Construction</b>	This department implements state policy in urban development. It is responsible for placing state orders for the supply of goods, rendering of services, processing of works for capital construction projects, and for the design, construction and reconstruction at the expense of the budget. The department also manages construction and demolition waste in Moscow.
<b>Department of Urban Planning Policy</b>	This department is also responsible for the development of the Moscow state policy in urban development and the coordination of the Programme of Renovation (see Section 4.2) and some other state programmes.
<b>Committee for Architecture and Urban Planning</b>	This committee is engaged in urban planning, including territorial planning and urban zoning. It is also responsible for the formation of the architectural and artistic appearance of Moscow.
<b>Territorial body of the Federal State Statistics Service of Moscow</b>	These are authorities responsible for disseminating official statistics on Moscow.
<b>Capital Overhaul Department</b>	The department develops and implements state programmes that would improve urban environment, public spaces and park areas. It is also involved in coordinating local activities for the development of transport infrastructure facilities and implementing the regional capital repair programme for housing.
<b>Mossvet (SUE)</b>	Responsible for lighting services in Moscow (technical supervision, registration, operation, maintenance of systems and databases, etc.).
<b>Mosvodostok (SUE)</b>	Provides the drainage of surface sewage into the city drainage system, as well as the technical operation of facilities of the centralised water disposal system in Moscow.
<b>Moscow United Energy Company (PJSC)</b>	Provides centralised heating and hot water supply to the capital (with the exception of small local heat supply areas from isolated departmental and corporate heat sources).
<b>Mosenergosbyt (PJSC)</b>	Moscow's energy sales company, which sells more than 8% of the electricity generated in Russia.
<b>Mosvodokanal (JSC)</b>	Provides services in the field of water supply and sanitation to Moscow and the Moscow region.

Entity	Function
<b>Information Technologies (IT) Department or Department of IT (DIT)</b>	This department develops public policies related to Information Technologies, deploys ICT solutions within the public sector, and oversees Moscow's smart infrastructure and applications. Its team is continually working to ensure that the opportunities offered by information technologies are being utilized by every resident of Moscow to receive the latest information on their surroundings and solve important issues in a timely manner.
<b>Department of Transport and Development of Road Infrastructure</b>	This department develops policy, provides services, and manages state property in transportation and infrastructure. It also ensures the safety of transport facilities and vehicles.
<b>Moscow Metro (SUE)</b>	This organisation operates the Moscow high-speed transportation system, which includes the Moscow Metro, the Moscow Monorail and the Moscow Central Ring.
<b>Mosgortrans (SUE)</b>	This organisation is responsible for urban and suburban transportation including buses, trolleybuses and trams.
<b>Moscow Administrative Road Inspectorate (SUE)</b>	Monitors compliance with the rules for stopping and parking vehicles in areas with traffic signs and markings, administrates parking tickets, monitors compliance with the rules for the carriage of passengers and luggage by taxi, and monitors compliance conditions of loading works at night.
<b>Department of Education</b>	This department is responsible for the formulation and implementation of education related policies in Moscow. It organizes and provides services for pre-school, primary, secondary, professional secondary, higher and additional education.
<b>Department of Healthcare</b>	This department is responsible for providing health related information and education, raising awareness on critical health issues, ensuring the accessibility of health services and monitoring their quality of them in Moscow. The department aims to enhance public healthcare by unlocking synergies and economies of scale. It also provides medicines and services for licensing in the health sector.
<b>Department of Labour and Social Protection of Population</b>	This department is responsible for forming and implementing policies related to the labour force and social protection in Moscow. It also provides social services and guidance on key issues to the population including the prevention of child neglect and delinquency, the promotion of employment and labour migration, labour protection and protection against unemployment, etc.



Entity	Function
<b>Department for Environmental Management and Protection</b>	This department organizes and coordinates the development of city-wide environmental programmes and deals with the environmental education of citizens. The department is also responsible for improving and sustaining a green environment in Moscow.
<b>State environmental conservation agency (Mosecomonitoring)</b>	The agency associated with the Department for Environmental Management and Protection that is responsible for the monitoring of Moscow's environment. It disseminates information on the state of atmospheric air, surface water bodies, soil, green plantation sites, groundwater quality, landslide processes and noise levels.
<b>Department of Sport and Tourism</b>	This department provides public services related to physical culture, sports, tourism and the hotel industry. It supports and develops athletes, promotes sports as a platform for nation building, and is responsible for the promotion of tourism in Moscow.
<b>State Inspection on the Quality of Agricultural Products, Raw Materials and Food</b>	The inspection body monitors the quality and safety of agricultural products, raw materials and foodstuffs purchased with the city budget and the budget of the territorial insurance fund.

Figure 8 is the organizational chart of departments and agencies at the Moscow City Government and other level(s) of government, and their relation to each other for the purposes of KPI data collection.



**Figure 8: Moscow's SSC project KPIs collection organization chart<sup>31</sup>**

It is expected that Moscow's experience in implementing the U4SSC KPIs for SSC will provide continuous support to the Smart Moscow 2030 strategy.<sup>32</sup> The project will assist the city in conducting a periodic internal review of its ICT-related efforts, thereby allowing the city to benchmark how ICTs can be used most effectively to monitor and improve its Smart City processes and operations.

## Second phase of the project

After the data were collected, an independent auditor<sup>33</sup> performed onsite validation and verification in 2018.

The independent verification of KPIs performed by Moscow as part of its ITU Smart Sustainable Cities (SSC) Project aimed to examine the collected data and documents. During this process, Moscow also provided feedback on the suitability of the KPIs, as well as and insights for future revisions based on Moscow's ability to collect and present verifiable data.

<sup>31</sup> Received as part of Smart City Lab's answers to ITU's pre- case study development Preliminary Questions.

<sup>32</sup> Received as part of Smart City Lab's answers to ITU's pre- case study development Preliminary Questions.

<sup>33</sup> John Smiciklas served as the auditor for this process.

The verification process included:

- in-person interviews with staff and management at the various entities in Moscow;
- an in-person review of the submitted KPI data;
- a review of the data presented prior to the on-site assessment; and
- a review of the underlying data sources.

### Third phase of the project

The final phase of the project involved the preparation of this case study. The objectives of the case study are to:

1. summarize all the activities conducted during the project;
2. review the suitability of the current KPIs in light of Moscow's situation;
3. highlight opportunities for improvement;
4. provide suggestions for aspiring smart sustainable cities; and
5. offer feedback to help refine the U4SSC KPIs.

The Smart City Lab has outlined the following expected outcomes following the publication of this case study.

- The estimation of the current status of Moscow as a Smart City.
- The identification of current weaknesses in Moscow's smart strategy for the benefit of future planning.
- The identification of new directions for Smart City development based on expert opinions.
- Determining the most efficient way to share best practices in the Smart City arena.

The following are considered to be the target audience for this published case study:<sup>34</sup>

- The Moscow City Government and governments of other cities in Russia, other CIS countries and around the world.
- The Federal Government of Russia.
- Moscow citizens.
- Non-profit organizations in the Smart City area.
- ICT Ministries of CIS countries.

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<sup>34</sup> Received as part of Smart City Lab's answers to ITU's pre-case study development Preliminary Questions.

### 3.2. Verification methodology and findings

The verification process of Moscow's reporting of U4SSC KPIs revealed the following findings:

<b>Total number of indicators</b>	<b>91</b>
KPIs verified: Data presented met the requirements of the KPI(s) and was verifiable.	76
No data reported	15 <sup>35</sup>

Almost 98 per cent of data reported was city (regional)<sup>36</sup> level data, while the remaining 2 per cent was national level data. Furthermore, close to 93 per cent of the KPI data reported was based on accurate measurements with just over 5 per cent of the KPIs reported was estimated based on certain assumptions and just over 1 per cent of KPIs reported was extrapolated based on survey of inhabitants.<sup>37</sup> The results were presented to Moscow in a formal verification report<sup>38</sup> in 2018.

The following graph (Figure 9) illustrates Moscow's fulfilment of its KPI reporting targets, i.e. the number of KPIs reported and verified successfully, according to the U4SSC KPI dimensions and sub-dimensions.

	Total	Reported	Verified	% KPIs verified of total KPIs
<b>Economy</b>				
Core KPIs	23	20	20	87%
Advanced KPIs	22	17	17	77%
<b>Environment</b>				
Core KPIs	13	11	11	85%
Advanced KPIs	5	3	3	75%
<b>Society &amp; Culture</b>				
Core KPIs	19	19	19	100%
Advanced KPIs	10	6	6	60%
<b>Overall</b>				
Core KPIs	55	50	50	91%
Advanced KPIs	36	26 <sup>39</sup>	26	72%
<b>Total</b>	<b>91</b>	<b>76</b>	<b>76</b>	<b>84%</b>

**Figure 9: Number of U4SSC KPIs successfully reported by Moscow**

<sup>35</sup> KPI SC: SH: SA: 3A Resilience Plans was not yet defined at the time of data collection and could not be reported by Moscow. It is included in the totals but not in the analysis.

<sup>36</sup> Because Moscow is a region of the Russian Federation (i.e. on par with other regions), Moscow regional and city level are the same within the context of data sources from various levels of government.

<sup>37</sup> Received as part of Smart City Lab's answers to ITU's pre- case study development Preliminary Questions.

<sup>38</sup> For privacy reasons, the entirety of these results has not been presented publicly and the verification report has been kept confidential.

<sup>39</sup> KPI SC: SH: SA: 3A Resilience Plans was not yet defined at the time of data collection and could not be reported by Moscow. It is included in the totals but not in further analysis within the case study.

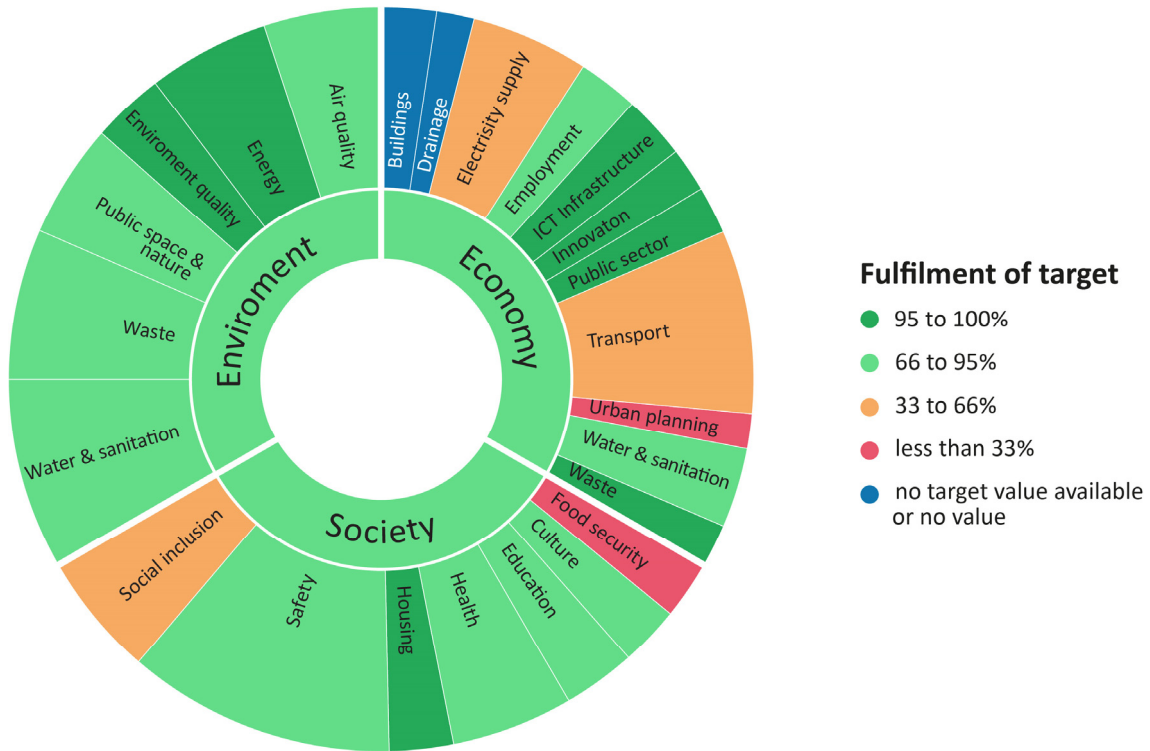


Figure 11: U4SSC KP results visualization

## 4. Moscow's smart sustainable initiatives

### 4.1. Overview

Prior to initiating the U4SSC KPIs for SSC project with ITU, Moscow had already developed and successfully implemented a number of smart and sustainable city initiatives (see Figure 11). This made the Russian capital the ideal testing ground for the U4SSC KPIs. With even more smart and sustainable initiatives already planned, it is expected that Moscow will be able to apply the KPIs to the existing Smart City initiatives, as well as to the upcoming ones, and provide valuable feedback on how:

- the KPIs fit into the current Information City and future Smart Moscow 2030 strategy frameworks;
- the KPIs could be used to measure an individual initiative's progress;
- the KPIs could be improved to better provide feedback; and
- new KPIs, if any, can be introduced to better measure a city's smart progress.

Furthermore, Moscow's upcoming Smart Moscow 2030 strategy shows that this project could play a key role in the city's smart sustainable future. The knowledge gained through Moscow's experience in implementing the U4SSC KPIs will continue to be an important part of ongoing efforts to make the U4SSC KPIs and ITU's upcoming Global Smart Sustainable Cities Index (see Box 2) the most effective methods to measure progress and provide guidance to cities around the world on their journey to becoming smarter and more sustainable.

The following sections will explore how Moscow's current smart initiatives correspond to each of the three dimensions of the U4SSC KPIs, namely 1) Economy, 2) Environment, and 3) Society and Culture. The focus within each of these sections will relate to the implementation of ICT

infrastructure and how that infrastructure is being used by the city's inhabitants. Figure 11 provides a brief overview of Moscow's smart sustainable initiatives.

## Smart sustainable Moscow

### Online state services

- Over 300 services in mos.ru
- 6.3 million users
- 44 services available online only

### E-school

- Online services for children and parents
- Online parent - teacher meetings
- Electronic record book
- Online panels

### Smart medicine

- Online appointment booking
- Electronic medical records
- Electronic prescriptions

### Citizen engagement

- Over 3 million participants in Active Citizen and Our City
- Over 81 million opinions collected
- Over 2 million problems solved

### Wi-Fi

### Video surveillance

### Smart transport

- Prompt traffic regulation
- Prioritization on public transport
- Management of all transport services
- Traffic enforcement cameras

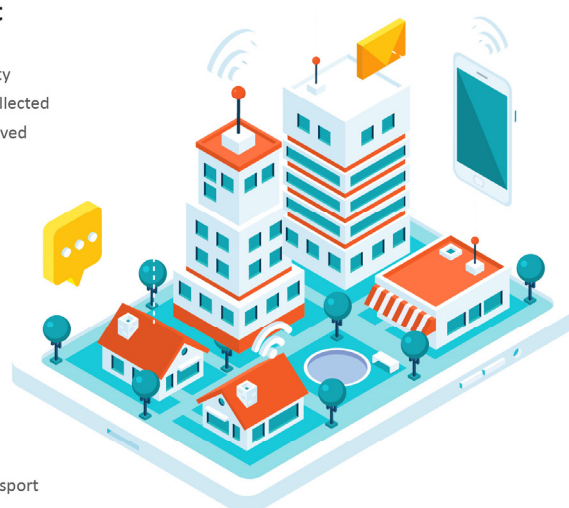


Figure 11: Moscow as a smart sustainable city<sup>40</sup>

## 4.2. Dimension # 1: Economy

The rapid expansion of ICT-related markets and the emergence of new areas of ICT usage are posing unprecedented challenges while simultaneously providing new public policy opportunities. This is reflected in the “Information Society Development Strategy in the Russian Federation”, the state programme “Information Society 2011-2020”, and in strategies for the development of information technology (IT) in the Russian Federation for 2014-2020 and up to 2025.<sup>41</sup>

One of the main directives of Moscow's current Smart City strategy is to provide a friendly environment for business development. There are around 30 technology parks and “technopolises” in Moscow which support more than 1 300 high-tech companies. Grants and subsidies for innovative small and medium enterprises (SMEs) are provided by the city government.<sup>42</sup> This is especially important, as 98 per cent of all businesses in Moscow are SMEs.

One of the long-term goals of the Smart Moscow 2030 strategy is to create an environment for innovation enabled by smart technologies. The power of information and communication technologies (ICTs) is central to achieving this long-term goal. Therefore, in order to expand its ICT capabilities, Moscow currently spends the equivalent to 2.26 per cent of its GDP on research and development efforts each year. Moscow's commitment to innovation has played a significant role in revitalizing the capital's economy and infrastructures. This section will examine

<sup>40</sup> <https://www.mos.ru/en/news/item/40697073/>

<sup>41</sup> Athar (2018)

<sup>42</sup> Athar (2018)



some of the key initiatives associated with improving its economic and innovative capabilities based on the findings from the U4SSC KPIs.

### Connectivity

The Moscow City Government has made significant investments, in order to provide its inhabitants with free Wi-Fi access across the city's streets, parks and other public and pedestrian areas. This includes close to 18 300 public Wi-Fi hotspots all over the city, more than 2 000 of which are located inside the Garden Ring and in Moscow's parks.

Internet can also be accessed within Moscow's public transport systems. The network covers the metro, the Moscow Central Circular (MCC), the Aeroexpress trains to airports, as well as Moscow's buses, trams and trolleybuses. Coverage and access are seamless. There is no need for users to re-authorise when changing from one mode of transport to another.

In the summer of 2017, Moscow's wireless service providers installed more than 1 000 4G base stations around the city. This helped eliminate any black spots where the high-speed service had not been available before, seamlessly covering the entire area of Moscow within the limits of the Moscow Automobile Ring road (MKAD). Ahead of the 2018 FIFA World Cup, further mobile network upgrades were made which helped lay the foundations for future 5G connectivity in the city.<sup>43</sup> 1 300 new cell towers, 55 mobile cell sites and 25 km of fibre were installed to keep spectators connected.

According to the IT Department, there are a total of more than 50 000 base stations in Moscow. The City Government has simplified the procedure for establishing base stations in non-residential areas, where the majority of base stations, or 75 percent, are located.<sup>44</sup>

Moscow is also among the top ten cities for fixed line broadband speed, which is on average 35 MB per second.<sup>45</sup>

Provision of such increased access to the internet at little or no cost empowers citizens and promotes the use of e-services without the burden of network costs. Notably, it helps to create a positive example for other developing cities towards the fulfillment of one of the United Nations (UN) Sustainable Development Goals (SDGs) target, namely SDG Target 9.C: "Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020."

Such a high level of connectivity also has positive implications for Moscow's economic development and growth. It underscores the inhabitants' access to new knowledge, open data, the latest news and communication that can be leveraged for economic productivity, i.e. training, education, research, business management, the exchange of ideas, and innovation. Accessible Wi-Fi and internet are the foundations of bringing smart services to citizens.

### Traffic control, smart public transport, accessibility and vehicle technology

One of the foremost challenges for large cities around the world is traffic congestion. Moscow's intelligent traffic control system is an important element in its response to this challenge. Moscow's traffic system includes more than 2 000 traffic lights, 3 500 traffic detectors and 2 000 CCTV cameras. Data from these devices are transferred to the city's Traffic Management

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<sup>43</sup> McCaskill (2018)

<sup>44</sup> <https://www.mos.ru/en/news/item/27053073/>

<sup>45</sup> <https://www.mos.ru/en/news/item/22489073/>

Centre's situation room (see Figures 12 and 13), where they can be analysed and used to help control and manage traffic. Figure 14 shows an example of the positive results experienced in Moscow due to active traffic management through ICTs.



**Figure 12: Moscow Traffic Management Centre's situation room**



**Figure 13: Moscow Traffic Management Centre's situation room**





**Figure 14: Typical flow of traffic - Tverskaya Zastava Square - Belorussky Railway Station<sup>46</sup>**

Moscow has also implemented a number of initiatives to reduce the need for private vehicle trips and encourage walking, cycling and car sharing as a means of travel. Moscow has introduced parking fees and reduced free parking spots in the city. At the same time, the city has implemented online maps and online payment for parking, in order to improve its efficiency. Drivers in Moscow are now spending less time idling at traffic lights or circling to find a parking spot. Nevertheless, Moscow continues to make alternative travelling and commuting methods more attractive and accessible.

As a further initiative to reduce congestion, Moscow is encouraging its citizens to take advantage of car-sharing programmes. Moscow provides free parking to car-sharing services, in order to lower the cost of operating these sharing programmes and incentivize the use of these services. Uber and other ride-hailing services are enabled and encouraged, with policies implemented that require the licensing of drivers to ensure public safety and security.

Recognizing that public transportation is one of the most efficient ways to relieve traffic congestion, Moscow has invested significantly in improving the city's public transport system.<sup>47</sup> As a result, Moscow's public transport system has become one of the world's largest and most effective. Its Metro system, for example, is ranked number 1 in the Western Hemisphere in terms of volumes of passengers (2.5 billion passengers) and number 1 on minimal headways maintained at all lines during all peak-hours (1.5 minutes). Managing this high volume of passengers is possible only with the implementation of IT-based tracking and signalling controls. Currently, nearly 60 per cent of Moscow's population have convenient access (i.e. within 0.5 kilometres) to public transport. In addition, Moscow's underground transit system was expanded dramatically between 2010 and 2018, with 78 new stations opened. The metro expansion is expected to continue as the Mayor of the Russian capital plans to double the length

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<sup>46</sup> <https://www.mos.ru/en/city/projects/vybor-moskvichey>

<sup>47</sup> Akyuz (2015)

of the lines and the number of stations by 2025.<sup>48</sup> Figure 15 shows a state-of-the-art Moscow Metro train.

Project Magistral<sup>49</sup> was a project designed to move people more conveniently around the city centre and outside the Sadovoe Ring. Magistral changes the routing of buses, trolleybuses and tramway services in the city in order to improve the reliability of surface transit. The project was implemented using anonymized SIM card data to map commuter movement and realign transportation services accordingly, in order to better serve Moscow's inhabitants based on their movement patterns.

The first line introduced as part of Project Magistral consolidated 39 land routes down to 17 routes. Within the first year of the project's implementation, passenger traffic on land transport increased by one-third. The routes introduced through Magistral are now used by 500 000 people every day, 130 000 of whom use the routes by Kremlin Ring, which is one-and-a half times more than before Magistral's implementation in 2016. Notably, the structure of passenger flow has improved significantly. Prior to the implementation of Magistral, commuters often had to transfer from one type of public transport to another before reaching their destination. Now, it is easier to travel by bus and tram without having to transfer, so creating a more reliable interval motion and making public transport more convenient for citizens.

In addition, thanks to the allocated lanes introduced as part of the project, surface transit now runs as regularly as subway trains. Muscovites quickly became used to this new and improved public transport infrastructure. The success of the project can be seen in its results. In 2011, Moscow was the second most congested city in Russia; in 2018, after the successful implementation of the project, Moscow ranked below the top 20 in the same category.

To increase efficiency and ease of payment for its transit customers, Moscow has also implemented a unified ticketing and payment system, The Troika Card. Troika Cards have now been wired into bracelets (as seen in Figure 16) and rings aimed at making the payment and movement process at transit terminals even easier for riders. Payment for tickets is also possible via other electronic payment methods, such as Samsung Pay and Apple Pay. All subway stations, bus stops, and soon even the city's electric buses, will offer phone/electronic device charging points.



**Figure 15: Moscow metro train**

<sup>48</sup> <http://eurasiatx.com/mosca-la-metro-si-rinnova-1600-vagoni-tre-anni/>

<sup>49</sup> <https://www.mos.ru/city/projects/magistral/>



**Figure 16: Troika bracelet<sup>50</sup>**

Furthermore, the Moscow metro application, available in Russian and English, also makes it possible to calculate trip prices, which is especially useful for tourists. It can also be used to recharge the Troika transport card, check a user's transit spending history or look for parking spots near the metro stations. The application also offers information on the main attractions in Moscow and helps users to create itineraries.

#### **Housing & communal utility services**

The Moscow Resource Monitoring and Management System has been functioning since 2015.<sup>51</sup> This system is one of the programmes approved by the government of Moscow to equip apartment buildings and social facilities with housekeeping meters for cold and hot water, as well as heating (The introduction of electricity is planned as well.) The meters in each building are connected to the Resource Monitoring and Management System and allow for:

- alerting on temperature mismatch and unauthorized turn-offs;
- monitoring utility consumption;
- monitoring the online status of meters; and
- remote management of heating.

There are two facilities that serve the needs of Moscow's citizens: the Unified Information and Calculation Centre and the Unified Dispatching Centre. The first is responsible for the calculation of the cost for housing and utility services. Around 3.9 million apartments are utilizing this system. The latter is the Contact Centre for requests related to housing and utility services.

It must be noted that the Smart Metering System - in the traditional sense (i.e. for every apartment) is ready to use and around 500 flats are already using it.

Furthermore, the city's Information Control System for Outdoor Lighting maintains the working capacity of outdoor lighting objects and monitors consumption through electricity meters. With

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<sup>50</sup> <https://www.mos.ru/en/news/item/33244073/>

<sup>51</sup> <https://www.mos.ru/city/projects/jkh>

the help of this system, the government can register lighting objects, estimate the costs for operation and maintenance, and control compliance with the standards of illumination. The system encompasses:

- 420 000 outdoor lightning pillars;
- 500 000 lamps;
- 6 800 power supply points; and
- 47 100 other objects of external illumination.

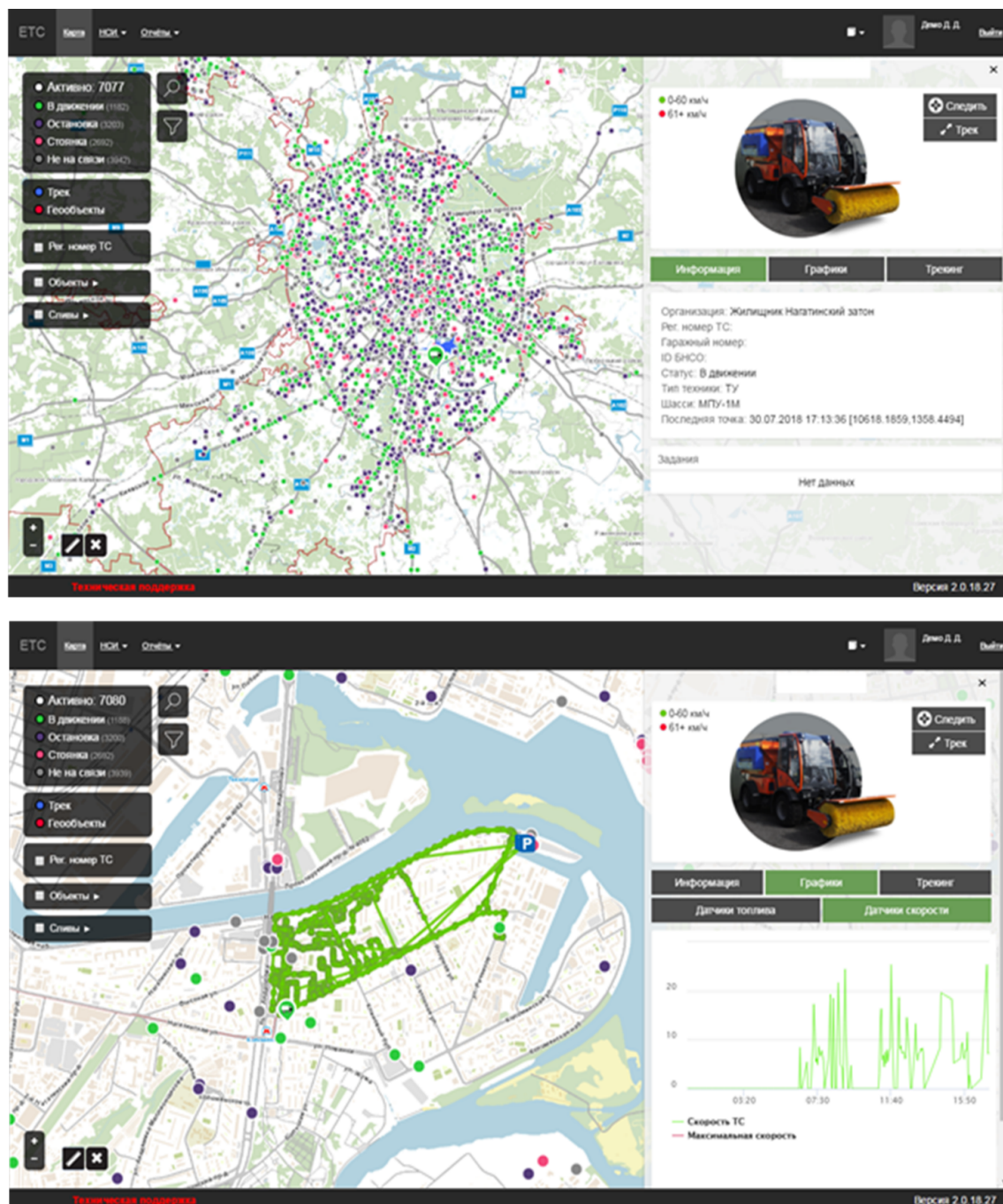
### **City vehicle management**

All of Moscow's municipal vehicles (more than 32 000) are now tracked and monitored through GLONASS. An Internal website (as seen in Figure 17) allows for the monitoring of different vehicle types, drivers' names, tasks to be done and completed, fuel consumption, position, and routes and speeds.

Through this management and monitoring system, Moscow is able to:

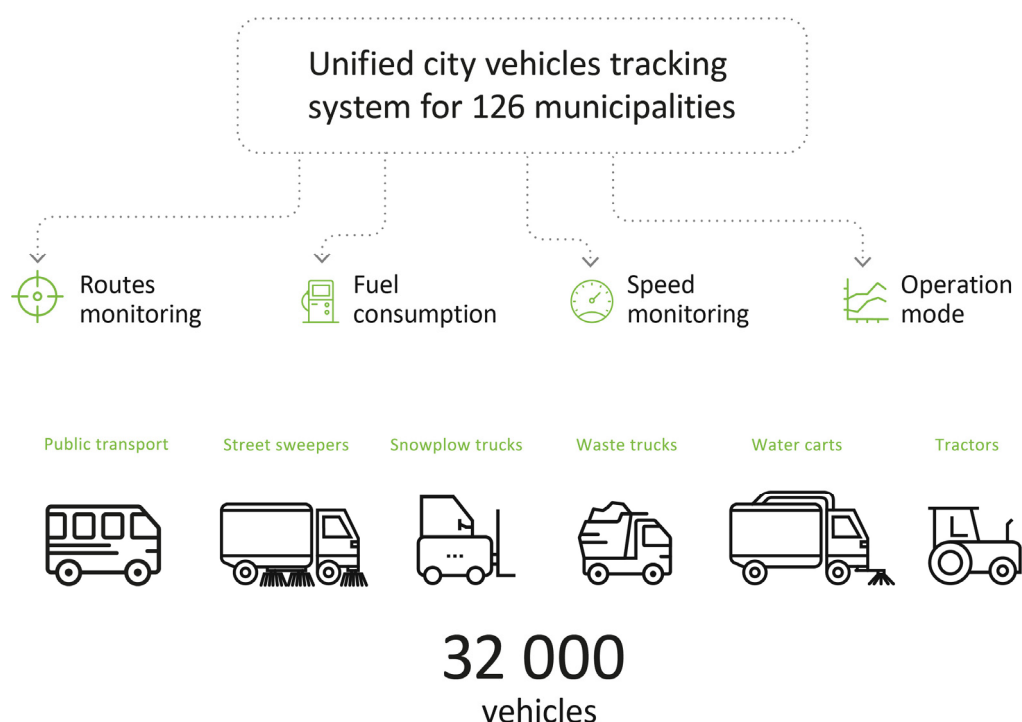
- determine if a vehicle's tasks (e.g. snow clearing) have been completed within specified time parameters;
- provide payments once the task is completed;
- monitor in real time the locations of all city vehicles and change deployments as needed; and
- collect data to improve the efficiency of delivery of services in the future.





**Figure 18: Moscow's unified city vehicle management system**

Figure 18 illustrates the type of public vehicles Moscow is tracking using the unified management and tracking system.



**Figure 18: Moscow City Vehicle Tracking**

### My Street

Moscow's My Street programme is the biggest urban redevelopment project in the world, with a 1.6 billion US dollars investment. Through My Street:

- 216.3 kilometres of Moscow's streets have been redeveloped in less than 3 years;
- 234 streets and 2417 historical buildings have been renovated;
- 12 788 trees have been planted;
- 0.5 million citizens have expressed their opinions on the redevelopment through e-voting; and
- 75 per cent of Moscow's citizens have expressed complete satisfaction with the redevelopment results.

The following images (Figures 19 and 20) illustrate the successful transformation of two areas, as an example, under the My Street programme.



**Figure 19: Gazetny Lane (2013 and 2017)**





**Figure 20: Vozdvizhenka Street (2013 and 2017)**

The successful revitalization project has produced visible positive results within the city. One such result is that the number of pedestrians on the redeveloped streets has increased by 70 per cent, with 30 per cent of Muscovites starting to walk more within the last few years.<sup>52</sup>

#### Open data

Open data provide many benefits for a city and its inhabitants. Open data are to the information/data on key topics that the government makes available to the public. Such data are often structured and machine-readable, and are allowed to be shared freely and used, and

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<sup>52</sup> Athar (2017)

built, upon without restriction. Open data facilitate government transparency, accountability and public participation in government by making statistics on key urban infrastructures available to the public. Open data also enable economic growth when the private sector utilizes these data for the purpose of innovation. This plays a key role in fostering the development of new applications and services for the city's inhabitants.

Moscow City Government recognized the importance of open data for innovation and accountability. An open data portal ([data.mos.ru](http://data.mos.ru)) was launched in January 2013. At present, more than 745 thematic datasets have been published on the portal, disclosing information on over 315 000 objects of urban infrastructure.

Other widely reported and widely accessed datasets through the portal include education, sports, health, and other additional key cultural and leisure areas. The data are presented in tabular and cartographic form for Moscow residents (and other similar users), and in machine-readable formats for developers. More than 30 mobile applications that utilize this data have already been successfully developed for the public. Information on the portal is updated regularly, and new socially important data is added based on users' requests.

### E-Services

E-government, defined by the Organization for Economic Co-operation and Development (OECD) as, "the use of information and communications technologies (ICTs), and particularly the Internet, to achieve better government"<sup>53</sup> aims to improve the relationship between the people and their government through advanced electronic and mobile services. It makes public services more effective, accessible and responsive to people's needs. It also encourages public participation in the decision-making process, making public institutions more transparent and accountable.

Furthermore, the United Nations General Assembly has recognized the role of ICTs in promoting sustainable development and supporting public policies and service delivery. The General Assembly has specifically affirmed the "potential of e-government in promoting transparency, accountability, efficiency and citizen engagement in public service delivery."<sup>54</sup>

OECD countries have also pledged their support to improve online access to information and government service quality by integrating ICT solutions into current service networks, enabling the delivery of services to citizens and businesses on their terms and at their convenience.<sup>55</sup>

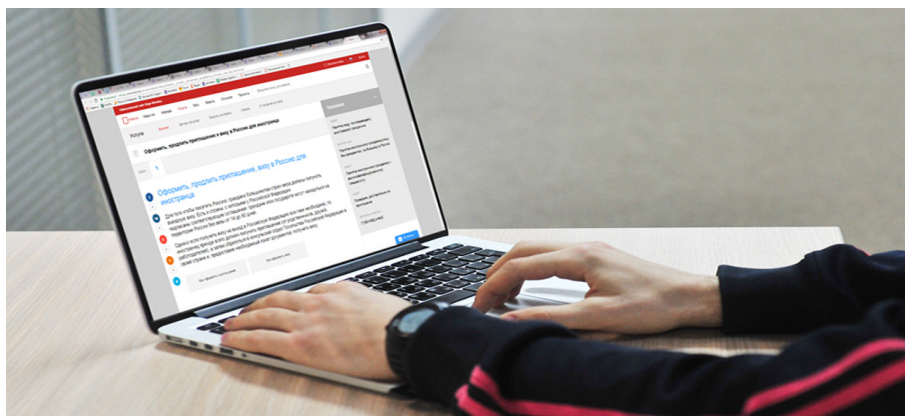
Moscow was the first Russian region to launch a website (as seen in Figure 21) where the public can pay various fees (e.g. check and pay traffic tickets and utility bills) and obtain city services (e.g. arrange a doctor's visit, top up a Troika card, sign up children for a club). Permits and documents were migrated to the cloud, so allowing users to receive several services in one package through the website. To date, Moscow has deployed over 200 e-services for citizens that can be accessed online through desktop and mobile applications.

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<sup>53</sup> Field, et al. (2004)

<sup>54</sup> United Nations E-government Survey 2016

<sup>55</sup> OECD. Implementing E-Government in OECD Countries: Experiences and Challenges (Background Paper).



**Figure 21: Government services portal on Mos.ru<sup>56</sup>**

E-Services are also available to assist parents in enrolling their child in kindergarten. For example, a pilot project that utilizes blockchain technology has been launched that would allow parents to place a request for a spot in kindergarten. The enrollment system would ensure that there is a verifiable record of their child's enrollment place in the queue. That enrollment record would remain valid and unchanged (unless or until a change is initiated by the parents).

### My Documents

Moscow has established My Documents centres (as seen in Figure 22) throughout the city where citizens can request and receive nearly 90 per cent of all government services. Since the first centre was opened in 2011, the programme has been expanded to include 131 centres. The locations of all centres are available on the [mos.ru](https://www.mos.ru) website where residents can check how busy each location is, and they are open 7 days a week with an average wait time for service of approximately 3 minutes.



**Figure 22: My Documents centre**

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<sup>56</sup> <https://www.mos.ru/en/news/item/29296073/>



Figures 23 to 26 highlight the extent of the services provided and the performance level measurements of the My Documents centres.

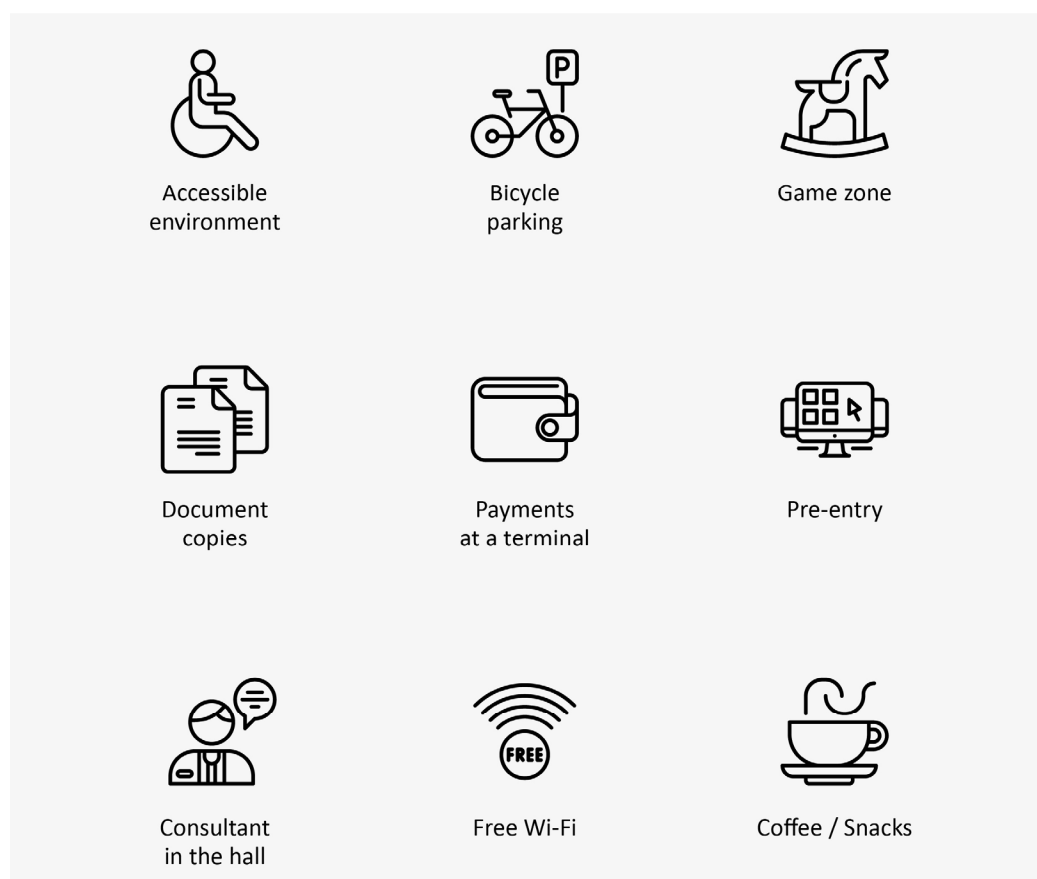


Figure 23: Ready service availability at My Documents centres

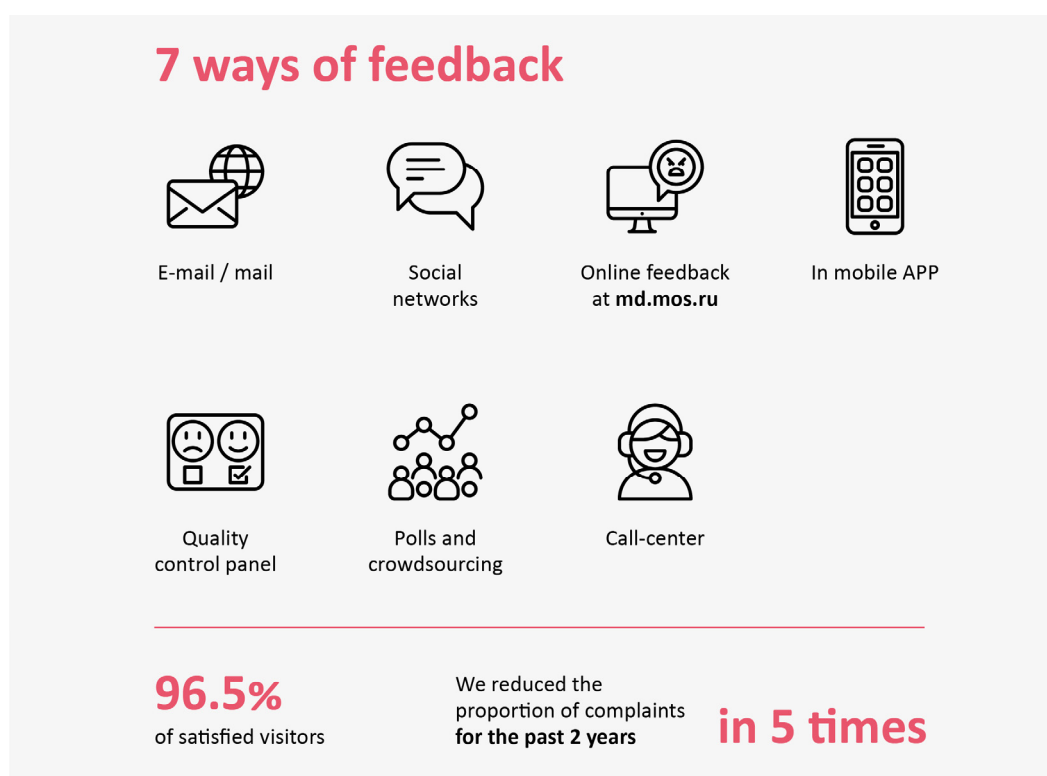


Figure 24: Effective queue management at My Documents centres





**Figure 25: Ease of use offered at My Documents centres**



**Figure 26: The many ways to connect with My Document centres**

### 4.3. Dimension # 2: Environment

The second dimension of the U4SSC KPIs is related to environmental sustainability and the environmental impact of a city (e.g. air quality indicators), as well as the impact of various factors concerning citizens' livability (e.g. accessibility to adequate green space). The KPIs also look at the use of ICTs in monitoring various aspects of the city's environmental performance and ensuring the efficiency of utility networks.

Moscow has recognized the importance of sustainability-related activities in its Smart Moscow 2030 strategy. For example, Moscow has implemented ICTs to monitor air quality, assist in compliance with international quality standards, and improve its water distribution network efficiency.

The recent key environmental smart sustainable initiatives in Moscow are explored as follows.

#### Green spaces and smart lighting

Green areas are important to the sustainability of a city. The benefits of green spaces include: capturing pollutants, reducing the "heat island" effect and providing recreational spaces. Green spaces can include parks, gardens, recreational areas, natural areas and other open green areas.

Moscow has developed several green initiatives, in order to create a sustainable, people-friendly urban environment for its inhabitants. In 2016, the city established 49 new parks. This was followed, in 2017, by an ambitious plan to upgrade more than 30 existing parks and establish more than 50 new park areas, including the Khodynskoye Pole Park, an art park at the ZIL industrial zone, the Mikhalkovo Estate, and the Brateyevskaya flood-plain. The city's My Street programme (see section 4.2) enhanced 61 streets in 2016, planting some 13 000 trees and 55 000 shrubs. Lime-tree alleys that were cut down on Tverskaya Street in the 1990s now thrive again, and trees have also been planted along the Garden Ring.

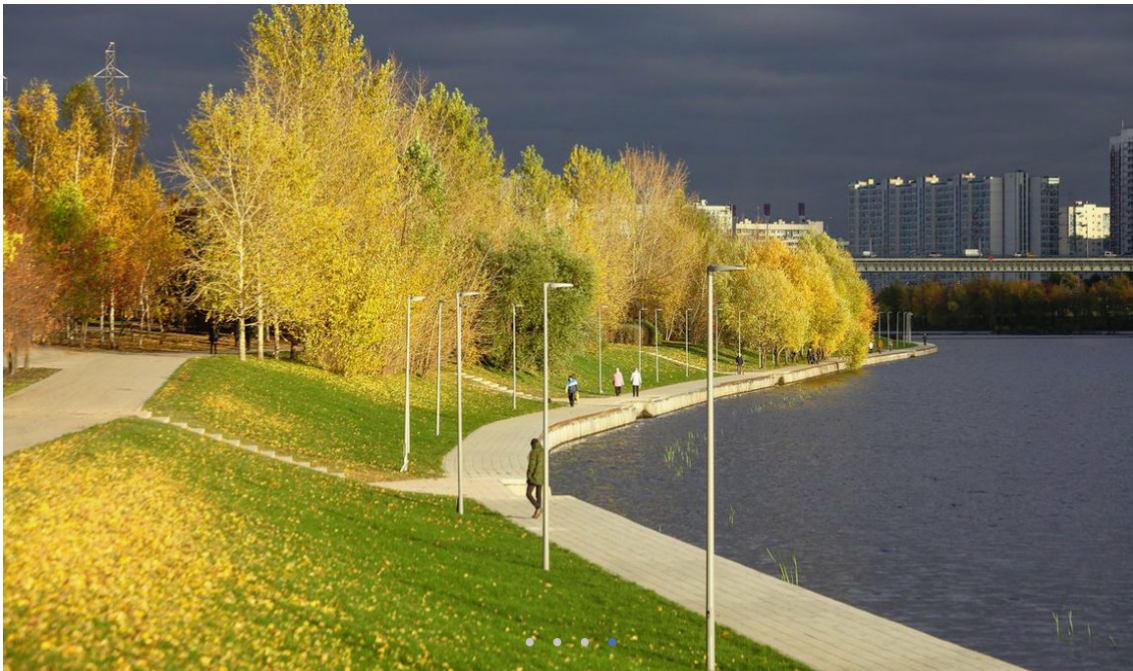
The "Million Trees" programme,<sup>57</sup> which started in 2013, is the largest landscaping programme in the city. The purpose of the programme is to decorate the courtyards of residential buildings with greenery. Muscovites can choose the courtyard they wish to plant trees, along with the types and varieties of plants via Active Citizen or by applying at the district council. In 2015, the programme was extended to the territory of social institutions. Since the implementation of the Million Trees Programme, 94 400 trees and more than 2 million shrubs have been planted.

Overall, the city has improved 437 public parks and nature areas since 2011. "We are focusing on the improvement of 'green' areas", Deputy Moscow Mayor, Pyotr Biryukov, noted in January 2017. "It should be said for comparison's sake that 130 'green' areas were established in 2010, and that this number was 455 last year (in 2016)," he added.

Streetlights that run on solar batteries have also been introduced to several parks since the beginning of 2012. As seen in Figure 27, these streetlights are, in fact, panels of light that do not require direct sunlight to generate electricity, on the contrary, they can function off of sunlight detected throughout the daytime. In some parks, such as Izmailovo, these panels also help power the park's internet connectivity.

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<sup>57</sup> <https://www.mos.ru/city/projects/mln-derevyev/>



**Figure 27: Smart lighting in a waterfront Moscow park<sup>58</sup>**

### Smart building energy monitoring

Buildings account for a significant portion of the energy usage and GHG emissions within a city. Reducing energy usage in buildings can lower GHG emissions, conserve valuable resources and mitigate against climate change. This is especially important in historic cities such as Moscow, where the majority of housing stock dates back to the post-World War II construction era.<sup>59</sup>

To this end, Moscow's power company is rolling out an IoT-based control system for utility resources which will detect how much electricity, water and heating a building consumes. The system currently covers more than 3 500 municipal buildings and more than 30 000 residential buildings, enhancing them with automated water and power consumption metering and billing.

Among the new smart building energy monitoring technology that Moscow already has put in place is the speech recognition system for a Unified Call Centre (777 77 77). This speech recognition system allows customers to use their voice to enter their electricity meter reading. Soon, a new mobile application, based on a chatbot, will also be introduced, allowing users to ask questions directly in chat mode.<sup>60</sup>

### Programme of renovation

Moscow's Programme of renovation is an ambitious project that will move 1 000 000 Muscovites to new apartments over the next 15 years. The goal of the project is to demolish and replace 5 171 old apartment buildings with new buildings and communities while keeping affected residents within the same area in which they currently reside. As part of the project, Moscow City Government has enacted new legislations pertaining to energy efficiency, fire codes, living

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<sup>58</sup> <https://www.mos.ru/en/city/projects/vybor-moskvicey>

<sup>59</sup> Paiho, et al. (2013).

<sup>60</sup> Kozlov (2017).

space and building materials. This new legislation improves the urban planning principles for these new communities by providing more public and private spaces, by building the latest ICT infrastructure for 5G implementation, and by implementing smart building technologies and meters.

#### **4.4. Dimension # 3: Society and culture**

The third dimension of the U4SSC KPIs for SSC explores the impact of ICTs in improving equity, governance, information flow and public participation. ICTs can provide a convenient platform for large-scale citizen engagement. ICT application is also the key to delivering information on government services and performance to the public. This dimension focuses on highlighting Moscow's efforts in improving different features related to quality of life, including education, health and safety.

Accordingly, Moscow has developed an extensive ICT system that can capture and integrate data for use by government, the business sector and private citizens. The key initiatives related to this dimension are explored below.

##### **Unified Medical Information Analysis System (UMIAS) and other health projects**

Moscow's Unified Medical Information Analysis System (UMIAS) was launched in 2011. The UMIAS is able to find the closest medical centre, arrange a doctor's visit (online, through a mobile app or at a terminal in a clinic) and obtain sick leave papers. The system can also issue prescriptions online. Since its launch, UMIAS has reduced lines in clinics by a factor of 2.5.

Currently, the UMIAS maintains the e-health records of 78 per cent of Moscow's inhabitants. An e-health record is a single file that contains the most up-to-date medical history of a patient. E-health records may also contain other information, including records on visits to health care providers, immunization history, imaging results and billing information. Since Moscow's e-health records are stored centrally and updated constantly, they can be an invaluable resource in emergency situations in which a patient is unable to communicate.

The UMIAS works at Moscow's 678 medical centres, uniting the city's 21 500 doctors (i.e. 421 physicians per 100 000 of its population) and 9.5 million patients, while performing 359 million arrangements and providing for over 500 000 transactions every day. About 700 000 people use the UMIAS to arrange to see a doctor every week. The next priority is to introduce the UMIAS to in-patient facilities and integrate it with ambulance services and Moscow schools. Figure 28 shows a UMIAS connected service terminal.



**Figure 28: UMIAS connected terminal at a medical centre**

A pilot project (separate from UMIAS) is being implemented for reviewing the efficacy of the current test protocol for lung and breast cancers. This pilot project uses an artificial intelligence (AI) programme to review MRI and CAT scans for cancer precursor cells. The AI programme is even capable of identifying the one pixel on a read-out that is a precursor to cancer. The pilot has so far helped 225 people in identifying the precursor to cancer at an early stage, something the existing process had not been able to do.<sup>61</sup>

Yet another pilot project uses UMIAS data and data from school attendance to predict potential virus outbreaks at schools. The data is then transferred to authorities who can inform students to stay at home, thus preventing the outbreak. The pilot programme, also using AI, has a success rate of 92 per cent.

### Electronic learning, teaching and school administration

The Moscow Electronic School project started in September 2016. The main elements of the project include digital school records, online registration, as well as an electronic library with textbooks, lesson scenarios and a large volume of curricula.

The lesson scenarios contained in the electronic library have now largely replaced traditional lesson plans, with a look that is more akin to presentations, along with additional materials and tasks. Teachers all around the city can find any scenario they need at the electronic library, add something new to an existing curriculum, or create a new one and share it with others. This system also allows teachers to exchange experiences and it fosters more innovation in teaching through interactivity within the systems. To date, Moscow's teachers have created more than 500 000 content units

Interactive blackboards – 84-inch touch screens – are also available in Moscow's schools and are used to make lessons more interesting for students (as seen in Figure 29). Students can draw on these e-boards, move on-screen elements around, paint various areas and perform other

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<sup>61</sup> GitHub | <https://medium.com/smart-city-moscow/just-over-a-year-ago-i-talked-about-our-project-on-early-diagnosis-of-lung-cancer-the-neural-70d7994bb443>



activities using a stylus or their fingers. The adoption of these e-boards familiarizes today's children with electronic devices while engaging in course materials. They enjoy history lessons where they can, for example, use an e-board to draw trade routes or circle areas where certain historic tribes lived. Subjects such as geometry benefit greatly through the availability of 3D imaging. And thanks to the readily available internet access in Moscow's schools, teachers can quickly pull up supplementary information such as laws, articles, videos and much more often on these interactive blackboards.



**Figure 29: Smart e-board in a Moscow primary school classroom**

Figure 30 shows the use of virtual reality (VR) equipment for learning in a post-secondary setting.



**Figure 30: Moscow students using VR goggles**



At present, 100 per cent of students in Moscow have access to ICT facilities in school. It is expected that dedicated Wi-Fi points will be made available in each classroom by the end of 2018.<sup>62</sup>

The positive effects of the adoption of such technology are vitally important and far reaching. It provides students and teachers alike with the fundamental ICT skills. The lack of such skills continues to be one of the key barriers preventing some people, in particular women and vulnerable groups, from enjoying the benefits of ICTs. The U4SSC KPIs help bridge this gap by evaluating and tracking the level of ICT proficiency among all citizens.

In addition, Moscow schools utilize online school performance evaluation and attendance records via the "Attendance and Food" and "Electronic Diary" systems. Through "Electronic Diary", parents can see their children's grades and education progress (such as which topics were covered in class on a given day, and what homework is due that week). "Attendance and Food" allows parents to monitor their child's arrival and departure times from school and keep track of what they had for lunch.

### Our city and Active Citizen

Muscovites can interact directly with the Moscow Government and influence their city's life. Our City (as seen in Figure 31) is a feedback channel where residents can comment on officials and utility service issues. The online forum relies significantly on mobile applications and hopes to encourage a community of citizen users who will help to keep their local government accountable.

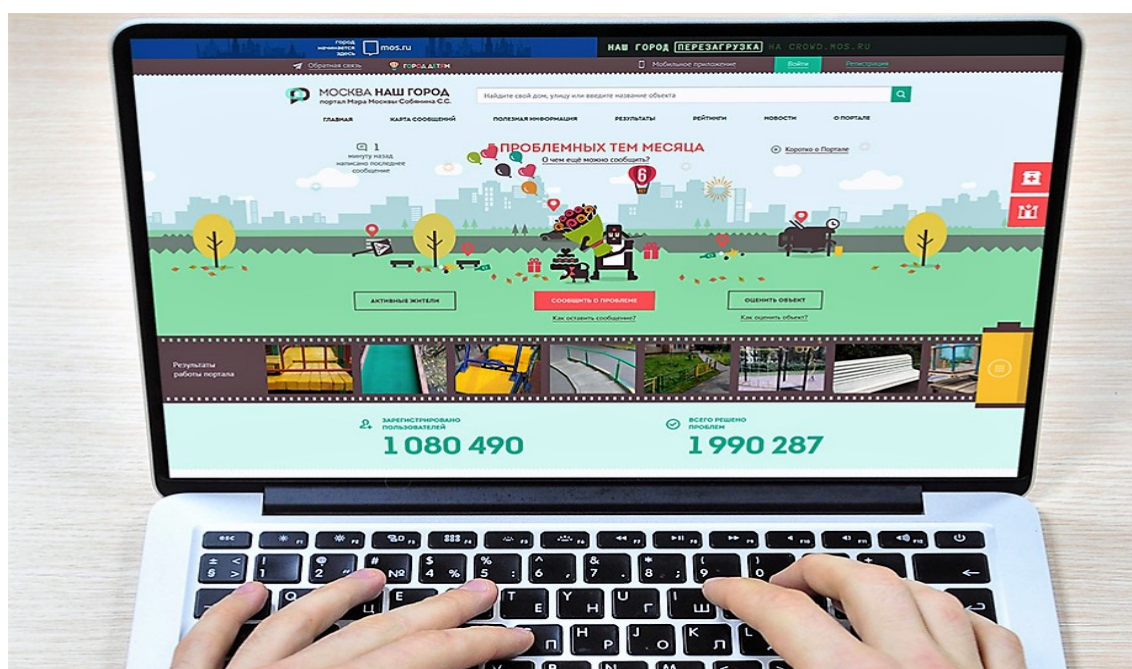


Figure 31: Our City interface

Muscovites can report, for example, on the lack of garbage receptacles in a park, any delay in their neighbourhood's garbage collection, a broken staircase or pavement tile, rubbish on the street, poor landscaping care, potholes, irregular electricity supply, and many other issues. As

<sup>62</sup> Russia Today (2017)

things stand, 1.2 million users are registered on the website, with almost 2.7 million problems reported through the channel having been resolved so far, 90 per cent of them within five days.

Another tool, Active Citizen, is an online referendum system, accessed through a website and corresponding mobile application, that allows citizens to vote on city development matters. These referendums have empowered residents to play a greater role in influencing the policies of their city, such as speed limits, new playgrounds or parks, sports complexes, additional bus routes, lawn mowing, the naming of the new metro ring and much more. Consequently, there is greater accountability on the municipality's part in helping to explore new avenues in public amenities.

"Active Citizens" awards bonus points that can be redeemed for brand souvenirs or tickets to theatres or museums. Today, more than 2.1 million participants are registered in the system, with more than 3 600 voting sessions held and over 100 million opinions considered.

Active Citizen has begun making use of blockchain technology to further improve the existing citizens' forum. It does this by heightening the level of transparency and authenticity with real-time vote tracking, thereby decreasing any potential ambiguity of resulting data.<sup>63</sup>

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<sup>63</sup> <https://www.mos.ru/en/news/item/34873073/>

## 5. Lessons learned from Moscow's experience in implementing the U4SSC KPIs

### 5.1. Introduction

Building cities that are inclusive, safe, resilient, smart and sustainable requires intensive policy coordination and investment choices. Once a city is built, its physical form and land use patterns can be locked in for generations, thereby rendering the process of changes extremely complex.

Furthermore, the transition to an energy-efficient and low-carbon city is by no means a short-term proposition. It entails fundamental changes in the city's economic and technical infrastructure, changes in the regulatory framework, mobilization and the coordination of all federal and regional executive authorities. It also entails changes in consumption patterns and other deeply rooted behavioral stereotypes within the various stakeholder groups.<sup>64</sup>

So far, Moscow's journey towards becoming a Smart Sustainable City has, in every respect, been rapid and successful. The swiftness of the intelligent planning, design, coordination and implementation of its SSC initiatives have improved the life of Muscovites considerably. This is especially impressive considering the sheer size and age of this European megacity.

This progress has been made possible mainly through the vision and financial commitment of various levels of government and private sector partners. This partnership is where the success of the current Information City and upcoming Smart Moscow 2030 strategies do, and will, lie.

As the Head of Moscow's Smart City Lab, Mr. Eldar Tuzmukhamedov, noted in 2017:<sup>65</sup>

*Smart cities must be a public-private partnership, and Moscow's experience is remarkable proof of this statement. The city shall not just spend its budget; it shall always aim to attract investment. Moscow uses investment contracts, creating and offering new models for the business.*

*Our free city Wi-Fi is built on (the) investment model: the companies spend their money on the infrastructure, and then make profit on advertisement. The same goes for the city CCTV system: the cameras are installed and maintained by mobile operators. It is a mutually beneficial cooperation, where we cut our expenses, and the business gets its profit.*

Moscow's publication of extensive open data sets (in number and comprehensiveness) is another area for potential future public and private partnership. Multiple applications that function as delivery platforms for these data have also already been developed with input from public actors.

Smart sustainable cities operate with a large volume of interconnected devices and components. Security concerns on data privacy, criminal misuse of public information, and other cybercrimes are legitimate concerns. In response, Moscow has already implemented strict regulations that require every department and agency to protect all data in their possession against the risks of

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<sup>64</sup> Girardi (2017)

<sup>65</sup> Coward (2017)

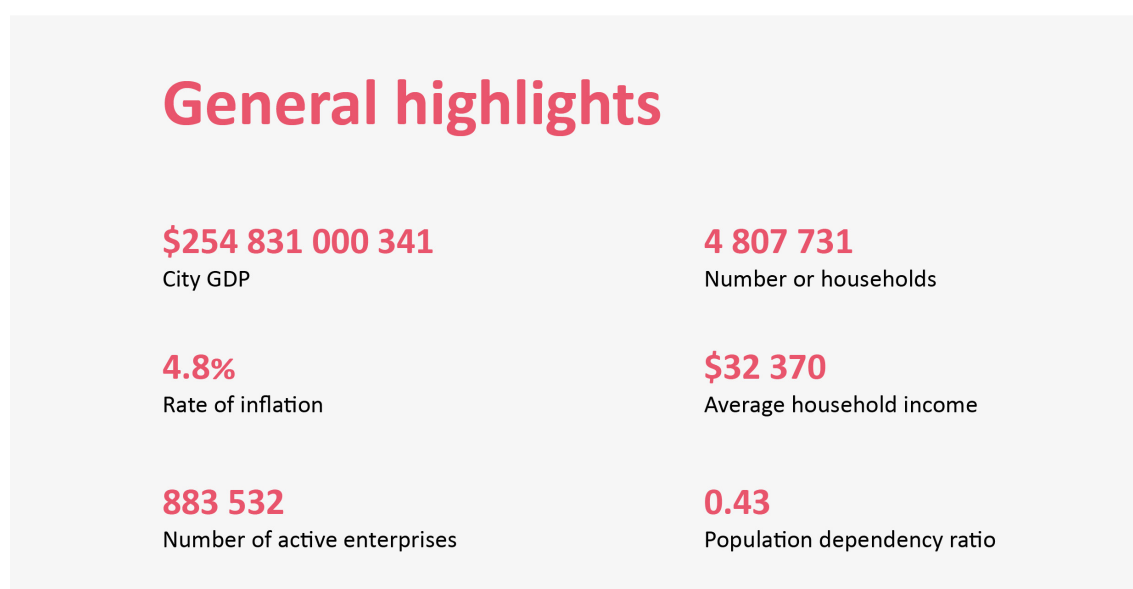
unauthorized access. Sensitive personal data, such as medical, tax and financial data, are protected under the law. Safeguards, including data encryption, secure storage and transmission requirements are mandated for all government departments and agencies. These regulations are in place to enforce the protection of data and will continue to evolve to ensure that data and devices are secure. This is key to enabling Moscow to move forward with its smart sustainable city strategy.

Given the strides Moscow has made in the domain of Smart Sustainable Cities and associated policies and laws, this section will highlight the lessons learned through the implementation of the U4SSC KPIs for SSC in Moscow and will provide suggested actions to similar cities accordingly.

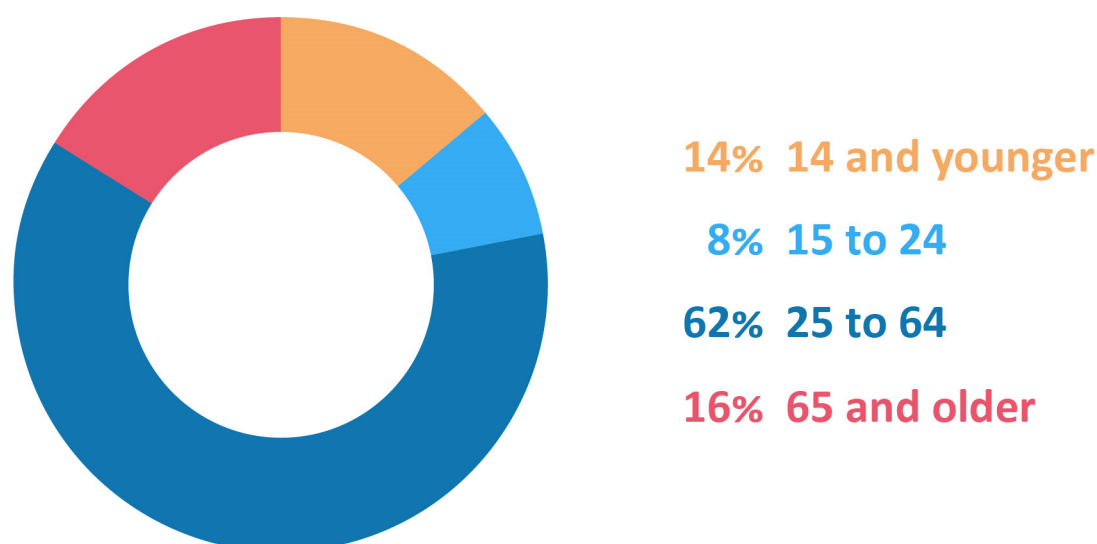
What follows is a review and analysis of key KPI data reported by Moscow. This section has two objectives:

- highlighting the lessons other cities can learn from Moscow when implementing smart sustainable city initiatives; and
- showing Moscow's progress in meeting the SDG goals and targets.

Figure 32 shows some general profile KPIs for Moscow, followed by Figure 33 that illustrates Moscow's population according to the major age groups.



**Figure 32: General profile of Moscow**



**Figure 33: Moscow's population by age group**

## 5.2. Moscow's performance: economy dimension

**99%**

Percentage of the city covered by wireless broadband

This includes both 3G and 4G wireless connectivity.

**100%**

Percentage of the water distribution system monitored by ICT

**102.41 km**

Length of public transport network per 100 000 inhabitants

The key theme assessed by these KPIs is the level of implementation of ICTs. A smart sustainable city requires fixed as well as mobile ICT infrastructures to allow for the deployment of applications that will:

- 1) facilitate the development of smart sustainable cities;
- 2) promote civic engagement; and
- 3) foster improvements in sustainability (gained through efficiencies in operations).

There are also KPIs within this dimension that are meant to help to analyze the general economic well-being and innovation of a city and measure the support from ICTs in the process.

Data collected under Moscow's U4SSC KPIs Project shows that Moscow, its citizens and the private sector, are developing and using ICTs to further the economic growth of their city and create a culture of innovation. Moscow is one of the world's largest metropolises.

While its size entails the abundance of natural resources

and cost advantages of economies of scale, organic growth in the economy sphere can still be challenging, leaving the threat of stagnation as a real possibility.

### Widely accessible and affordable Internet

The analysis of Moscow's SSC results starts with connectivity. Internet access at home is highly prevalent, with 90 per cent of all households within the city having access to the internet, mostly in the form of reliable fixed broadband subscriptions (85% of households have wired, i.e. fixed, broadband access).

*This is much higher than the average penetration rate of approximately 30%, as reported by the OECD, and reports well to two important UN indicators: SDG Indicator 17.6.2: Fixed Internet broadband subscriptions per 100 inhabitants, by speed, and SDG Indicator 17.8.1: Proportion of individuals using the Internet.*

Mobile internet is also highly prevalent, with an impressive 98.9 per cent of the city served by 4G, and 99.6 per cent with 3G wireless broadband. At the same time, mobile internet remains affordable. It costs Muscovites eight times less to access mobile internet than New Yorkers. This is particularly important as most Smart City applications are now usually accessed through mobile applications. High speed mobile internet capabilities are required in order to take advantage of these applications.

*Coverage of high-speed mobile internet from providers, therefore, is key to enabling these capabilities, and is also important within the context of SDG Indicator 17.8.1: Proportion of individuals using the Internet, SDG Indicator 9.C.1: Percentage of population covered by a mobile network, by technology, and SDG Indicator 5.B.1: Proportion of individuals who own a mobile telephone, by sex.*

Widely accessible and affordable internet connection has fostered a high-tech, knowledge-based economy that allows Moscow to compete in the global marketplace. It offers opportunities for further direct investments just as other global high-tech centres are experiencing saturation. It is vital that Moscow's public policy continues to foster and incentivize further scientific innovation and technological growth via smart applications. The U4SSC KPI Number of new patents granted per 100 000 inhabitants per year, for which Moscow reported a value of 71.59 in 2017, is an indicator that can contribute to monitoring the effectiveness of such innovation-related public policy. Surprisingly, for a highly innovative city, Moscow does not invest too much in research and development (R&D), spending just 2.26 per cent on R&D as a percentage of the city's GDP. A closer look shows that this is made possible by Moscow's high level of partnership with the private sector, with many key ICT initiatives in the city (such as surveillance cameras) being funded by establishing a working relationship with private entities.

## Transport

At present, 100 per cent of Moscow's major road infrastructures (e.g. highways and arterial roads) are monitored electronically by in-road sensors or cameras (or a combination of the two), and 51.41 per cent of Moscow's signal-controlled road intersections use adaptive traffic control or prioritization measures that allow for the traffic signals to respond to on-going traffic patterns. Adaptive traffic control and **prioritization measurements include embedded road sensors that change traffic signals based on actual vehicle flow and other comparable sensors that provide similar functions**. This can lead to less idling time for cars at intersections and better traffic flow. Currently, this ratio of travel time during peak periods to travel time at free flow periods is 1.82 in Moscow.

Every single urban public transport stop in Moscow offers dynamic travel information in real time. This holds true for Moscow's entire public transport network of 12 801 kilometres (one way) or 102.41 km per 100 000 of the city's inhabitants, including both high capacity (e.g. heavy rail, metro, subway systems and commuter rail systems) and light capacity (e.g. light rail streetcars and trams, buses, trolleybuses) components of the overall traffic system. This is made possible because all of the city's vehicles, including public transport and municipal vehicles, are



now connected to a centralized platform that makes it possible to monitor their operation, analyze their speed and location, and thus provide drivers with optimized routes and schedules.

The positive net result of Moscow's ICT-based transport infrastructure investment can be seen through its transportation mode share KPIs, which refer to the percentage of people in the city using the various forms of transportation to travel to work. Since traffic congestion is highest during rush hours, collecting data during these hours is vital in devising strategies to reduce congestion. An improving trend and higher values for public and more sustainable options are considered positive, as can be seen in Moscow's mode share breakdown in Figure 34.

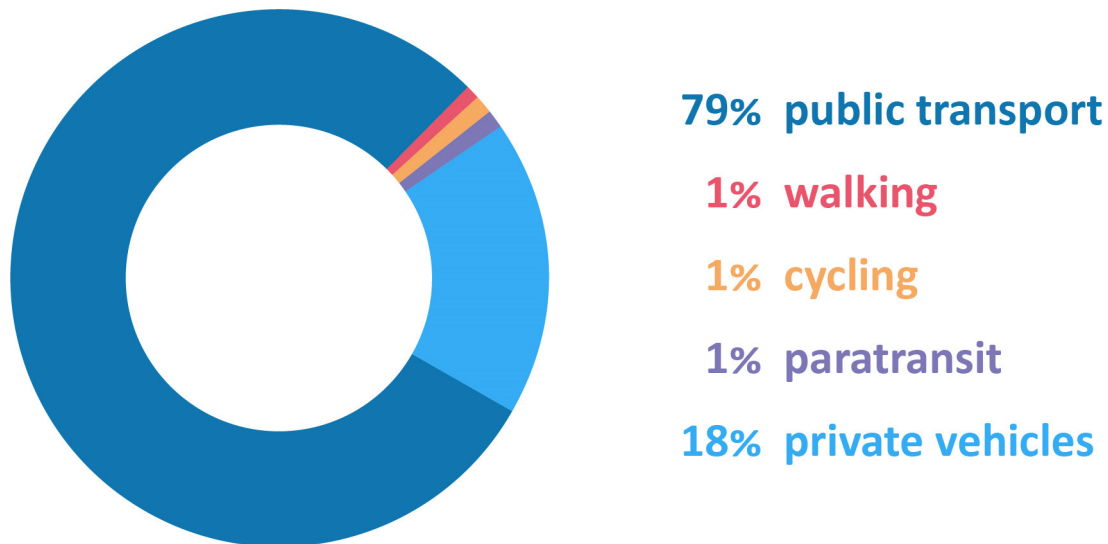


Figure 34: Moscow's transportation mode share

*All of the above is especially important for a city is to meet the UN SDG Target 11.2: By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older person.*

#### Water, wastewater and waste collection

Another aspect of a city's non-ICT infrastructure is its water supply. One hundred per cent of Moscow's households have access to basic water sources and safely managed potable (i.e. drinking) water services. Moscow consumes 137 litres (L) each day per capita of water, 100 per cent of which is freshwater consumption. Currently, 100 per cent of households are also covered by an audited Water Safety Plan.

Similarly, 100 per cent of all Moscow households have access to wastewater and solid waste collection services, as well as adequate sanitation facilities.

#### Employment

Moscow's significant investment in ICTs has resulted in a vibrant economy. This is reflected in its low overall and youth unemployment rates (1.27% and 0.17% respectively). ICT sector employment in the city is growing at 4.41 per cent of the city's labour force. With its increased attractiveness as a high-tech city, Moscow's tourism sector is also expected to grow creating

more potential jobs in the tourism sector which currently accounts for only 0.43 per cent of the city's labour force works. This bodes well for the prospects of the more than 65 per cent of Moscow's population eligible to work (which is also reflected in the city's positive dependency ratio of 0.43).

## Public services

Public services in Moscow has been vastly improved. There are now 222 services on Mos.ru, for a total reported of 250 public services delivered through electronic means. In addition, 100 per cent of Moscow's public-sector procurement activities are being conducted electronically. By managing procurement transactions (e.g. bids, requests for proposal [RFP], invoices, payments) on electronic platforms, the efficiency of government operations has been improved significantly, which allows for a wider base of suppliers to access potential government business.

*Moscow's public e-services contribute towards meeting UN SDG Target 16.6: Develop effective, accountable and transparent institutions at all levels, and SDG Target 16.7 Ensure responsive, inclusive, participatory and representative decision-making at all levels.*

The following list summarizes the key measures adopted by Moscow within the U4SSC Economy dimension and offers further suggestions for other aspiring Smart Sustainable Cities, as well as for Moscow.

Measures adopted by Moscow	Suggested action(s) for Moscow and other aspiring Smart Sustainable Cities
<p>Moscow provides free or affordable Wi-Fi, 3G and 4G services, which forms the ICT backbone of its Information City and Smart Moscow 2030 strategies (see section 4.2).</p> <p>The reported KPIs in the ICT domain demonstrate that Moscow has maintained a high level of development in this area, with a view to upgrading connectivity where possible in the future.</p>	<p>Urban stakeholders, in line with their Smart City goals, should also strive to provide free or affordable internet access to the public and to make concrete efforts to expand the wireless spectrum in the future</p> <p>Feasibility studies into the cost, scalability and applicability are recommended, as are the exploration of alternatives such as leveraging already existing private networks to form partitioned public networks of community hotspots. The latter would require additional cyber security, bandwidth control, quality of service and privacy regulation considerations.<sup>66</sup></p>
<p>Moscow regularly supports the 98% of all of the city's enterprises that identify as SMEs, by offering free programmes, courses, webinars and training sessions that empower SME owners and operators with new business related knowledge. These range from the very basics of running a business, to how to enter foreign markets, to ways to enter the procurement market, to ways to</p>	<p>It is recommended that aspiring smart sustainable cities similarly invest in their SMEs, as they are the backbone of any city's economy and can offer the highest potential for investment returns.</p> <p>Research shows that a city's continued growth is based, in part, on its ability to promote knowledge creation and sharing. The Centre for Cities found that a wide base of SMEs results in "knowledge-intensive economies that benefit from</p>

<sup>66</sup> Weiss (2015)

Measures adopted by Moscow	Suggested action(s) for Moscow and other aspiring Smart Sustainable Cities
<p>market the business efficiently, to dealing with regulatory authorities.</p> <p>For example, English language training was offered to the service industry and SMEs ahead of the 2018 Soccer World Cup, and rent savings at co-working and high-tech shared use centres are on offer.<sup>67</sup></p>	<p>relationships between firms of related but varied industries that look to reinvent and innovate. Cities which have strengths in these sectors benefit not only from the growth of these industries, but also from improved productivity in other firms.”<sup>68</sup></p> <p>Additionally, aspiring smart sustainable cities should foster growth among SMEs in the highly skilled, innovative sectors by ensuring that:</p> <ul style="list-style-type: none"> <li>▪ SMEs are able to access skills and knowledge;</li> <li>▪ SMEs have access to high performing digital infrastructure;</li> <li>▪ SMEs are supported to trade internationally; and</li> <li>▪ suitable premises (are provided) for sole traders and expanding small businesses.<sup>69</sup></li> </ul>
<p>Smart city systems tend to generate large volumes of data, including sensitive data containing the personal information of citizens. Within its Smart City strategy, Moscow recognizes that data security is critical to ensuring that citizens’ data are protected, and that smart systems and applications are available and can operate as needed.</p> <p>Mr. Andrey Belozerov, Strategy and Innovations Advisor to the CIO of Moscow has stated that, “data security is protected by hardware, software, audits, data transfer channels and labour contracts stipulating that if a government employee misuses someone’s data, they can be penalized or dismissed. Cyber security is mandated by high safety standards set by national and regional government, but the city is also testing its processes to identify and rectify weaknesses.”<sup>70</sup></p>	<p>Appropriate measures must be taken by every city looking to employ ICTs (and the resulting data) to ensure that collected data are secured and protected by law, in order to thwart misuse of information and unauthorized access.</p> <p>This is key to engendering trust in, and swift adoption of, ICT-based service delivery systems, in order to capitalize fully on the efficiency and over-time cost savings that ICT-based solutions represent.</p> <p>The use of blockchain, AI-based bot protection and multi-factor authentication to defend the city’s digital infrastructure should also be explored.</p>

<sup>67</sup> [www.mos.ru/en/news/item/40739073/](http://www.mos.ru/en/news/item/40739073/)

<sup>68</sup> Centre for Cities (2015)

<sup>69</sup> Centre for Cities (2015)

<sup>70</sup> Simpson (2017)

Measures adopted by Moscow	Suggested action(s) for Moscow and other aspiring Smart Sustainable Cities
<p>Moscow has a high level of ICT road and public transport network monitoring covering 100 per cent percent of highways and major arterial roads. A number of other local access roads are also monitored via ICTs. Adaptive traffic control is commonly employed, and the Traffic Management Centre is increasingly being expected to employ artificial intelligence (AI), in order to manage all city traffic proactively. Through the continuing expansion of the city's smart high-tech public transport network, traffic congestion has been eased from the high levels previously experienced.</p> <p>Notably, in the last few years alone, Moscow has added or experienced the following<sup>71</sup>:</p> <ul style="list-style-type: none"> <li>▪ 17 new major public transport routes in the areas where it was not available before;</li> <li>▪ 400 modern bus stops with free Wi-Fi and USB charging stations;</li> <li>▪ 151 new passenger shelters with easy directions, displays, free Wi-Fi and ticket vending machines;</li> <li>▪ average speed in the city centre increased by 7%; and</li> <li>▪ total amount of traffic accidents decreased by 37%.</li> </ul>	<p>City stakeholders are encouraged to implement ICT systems as the basis for developing a more efficient road system, decrease traffic flows and reduce the environmental effects of congestion through provision of city-wide smart and affordable public transport.</p> <p>A more effective approach to urban development is to consider, where possible, the role of ICTs up front in city development. Technical, application and market model trends that would have impact on the infrastructure of the aspiring Smart City must be taken into account.<sup>72</sup> It is recommended that cities develop, if possible, an ICT master plan that runs parallel to, and is a component of, the city's master plan.<sup>73</sup></p> <p>Cities should reference "ITU-T Y.Suppl.33 to ITU-T Y.4000 series "Smart Sustainable Cities – Master Plan" as a guideline.<sup>74</sup></p> <p>The above can be achieved only with the full cooperation and backing of various levels of government, politicians, the private sector and other key relevant stakeholder groups. Strategic and targeted support cultivation efforts are, therefore, also recommended.</p>
<p>Moscow's My Street programme has revitalized not only the city's parks and green spaces, but also a significant percentage of paved public areas and historical buildings. For example, through the programme, sidewalks were made by 50-200% wider, 400+ ground-level pedestrian crossings were created and 600 km of air cables were moved underground.</p> <p>The key factor in the programme's success is that it implements a holistic, multi-focal view of the city's revitalization.<sup>75</sup></p>	<p>Urban stakeholders are encouraged to facilitate regular dialogue between citizens, investors and decision makers within the city, in order to best tailor city revitalization efforts to the citizens' preferences, and thereby to meet with their approval.</p>

<sup>71</sup> Athar (2018)

<sup>72</sup> Deloitte (2017)

<sup>73</sup> Dave et al. (2010)

<sup>74</sup> <https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=12759>

<sup>75</sup> Athar (2018)

### 5.3. Moscow's performance: Environment dimension

This dimension examines the level of ICT integration in supporting the city's environmental sustainability and energy efficiency. These KPIs also provide a baseline for future comparisons.

Data collected for the U4SSC KPIs shows that Moscow has a well-developed system that monitors air and water quality. Moscow is also implementing ICT programmes to better manage progress in this area.

Achieving the efficient use of resources via ICTs will be key to Moscow's long-term environmental sustainability. Given the city's size, energy utilization does make up a significant portion of the city's environmental footprint.

**137 litres per day**

Water consumption per capita

**1 152.31 hectares**

Green areas per 100 000 inhabitants

**3 209.51 kWh per year**

Electricity consumption per capita

#### Green spaces and air quality

The analysis of Moscow's environmental initiatives starts with its green efforts that have led to the creation of 1 152.31 hectares of green areas in the city per 100 000 of its inhabitants. The accessibility of green spaces is equally important as these lead to a higher quality of life for the city's inhabitants. However, the percentage of inhabitants with access to the city's green areas, i.e. those living within 300 metres of a publicly accessible green space, currently remains in progress at 34.93 per cent.

Moscow's air quality KPIs are typical for a city of its size and economic/industrial makeup indicating that improvements are possible. Moscow measures  $17 \mu\text{g} / \text{m}^3$  and  $27 \mu\text{g} / \text{m}^3$  respectively on the air quality index (AQI) based on its reported values for particulate matter (PM2.5 and PM10). Nitrogen dioxide (NO<sub>2</sub>) is typically  $33 \mu\text{g} / \text{m}^3$  and sulphur dioxide (SO<sub>2</sub>) and ozone (O<sub>3</sub>) are  $3 \mu\text{g} / \text{m}^3$  and  $28 \mu\text{g} / \text{m}^3$  respectively, on average.

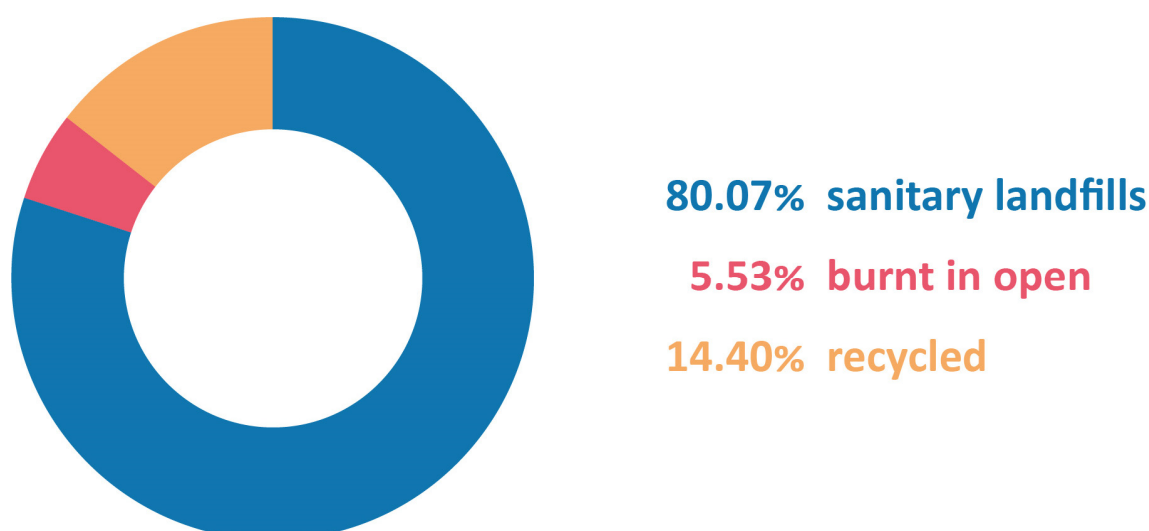
#### Transportation alternatives

Moscow's environmental sustainability benefits from the burgeoning shared economy in the city, especially from the shared modes of transportation. There are now 34.4 shared bicycles available and 88 shared vehicles per 100 000 of the city's inhabitants.

However, the number of electric vehicles in Moscow remains low, currently amounting to only 0.05 per cent of all vehicles in Moscow. Raising awareness on the environmental impacts of traditional transportation will also generate interest for plug-in hybrid electric vehicles (PHEV) and other electric vehicles (EV) and other low emission vehicles in the city.

#### Wastewater treatment and waste disposal

As regards disposal, 100 per cent of Moscow's wastewater receives primary, secondary and tertiary treatment. Figure 35 illustrates how Moscow's solid waste is disposed of, and shows that there is an opportunity to move more to a circular economy by increasing recycling rates. A reduction in the open burning of waste would have the benefit of improving air quality.



**Figure 35: Methods of solid waste disposal in Moscow**

### Energy usage

When it comes to energy usage, Moscow's annual public building energy consumption was reported to be 3 117.41 kWh per square metre (m<sup>2</sup>) in 2017, with 24.91 gigajoules (GJ) per capita reported for residential thermal energy consumption. Total annual electricity consumption in Moscow is 3 209.51 kWh per capita.

Sustainability certifications of public buildings and the use of ICT systems to automate building systems for energy and water savings is an area that is still to be reported.

At present, only 0.26 per cent of water metres in the city are smart metres. This is expected to increase with a city-wide revamp of buildings that is already underway. However, 100 per cent of the water distribution system is monitored by ICTs. It is recommended that Moscow also monitors and regularly reports on, the rate of water loss in its systems, in order to determine the extent and cost of the losses and the potential improvement opportunities.

Similarly, only 14.35 per cent of all electricity metres installed in the city are smart meters. However, there are plans to increase the deployment of smart meters. Currently, 80 per cent of Moscow's electricity supply system is monitored by ICTs.

As noted above, transition to an energy-efficient economy is not a short-term proposition. It entails fundamental changes in the city's economy structure and in its technical infrastructure, as well as changes in the regulatory framework, in the mobilization and coordination of all federal and regional executive authorities, in the consumption structure, and in behavioural stereotypes.<sup>76</sup>

As previously noted, achieving efficient resource use via ICTs will be key to Moscow's long-term environmental sustainability. Demand response penetration, for example, is an area where ICTs can help to increase the percentage of customers with sustainable demand response capabilities even further. Currently, 44.71 per cent of Moscow's electricity customers have demand response capabilities.

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<sup>76</sup> Girardi (2017)



*Continued steady progress in Moscow and partnership with the private sector is needed, therefore, to meet the UN SDG Target 7.3: By 2030, double the global rate of improvement in energy efficiency.*

*All of the above is also important towards reporting of the UN SDG Indicator 11.7.1: The average share of the built-up area of cities that is open space for public use for all, disaggregated by age group, sex and persons with disabilities.*

The following list summarizes the key measures adopted by Moscow within the U4SSC Environment dimension and offers further suggestions for other aspiring Smart Sustainable Cities, as well as Moscow.

Measures adopted by Moscow	Suggested action(s) for Moscow and other aspiring Smart Sustainable Cities
<p>As part of a broader federal mandate, Moscow has initiated a significant revamp of its residential and public building stock. More than 5 000 buildings will be replaced completely over the next fifteen years. While it is a significant undertaking in a size the city of Moscow that has a significant majority of post-World War II buildings (currently aging micro-districts account for 80% of Moscow's urban areas), this presents opportunities to not merely update the buildings architecturally or through new lighting, but also to install utility and building-management systems that will interact with the city's overseeing ICT systems.</p> <p>These measures are particularly important, given the continual residential and commercial demand for sustainable housing due to an ever-increasing population. Since the 1950s, Moscow's population has grown by roughly 1.5 million people every decade, mostly through internal migration.<sup>77</sup></p>	<p>Moscow and other urban stakeholders should adopt energy and water efficiency standards for new buildings (particularly in commercial projects) to decrease the life cycle environmental impact of new buildings.</p> <p>Moscow and other aspiring smart, sustainable cities should review Draft Recommendation ITU-T L.1370 (ex. L.SIB) "Sustainable and Intelligent Building services" as a source for improving the sustainability performance of existing buildings. This Recommendation also defines the services enabled by the sustainable and intelligent building (SIB) concept, the way it contributes to the aforementioned goals of sustainability, its features, its different possible functioning modes, or its internal architecture and requirements with the IoT node at its core.</p> <p>In addition, Moscow and other aspiring smart sustainable cities should investigate the use of sustainability certification programmes for on-going building operations, as these programmes provide a standardized method for optimizing the environmental performance of existing and new building stock.</p> <p>Moscow should become involved in and contribute to a New Work Item that was approved in ITU-T Study Group 5 "Environment, Climate Change and Circular Economy" on draft Recommendation ITU-T L.SP_OB, "A methodology for improving, assessing and scoring the sustainability performance of office buildings" as this Recommendation will develop a standardized methodology for improving the environmental performance of existing office buildings.</p> <p>Aspiring smart sustainable cities are also recommended to implement urban planning strategies that focus on walkable communities, increasing public and private spaces, and mandating smart and sustainable buildings.</p>

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<sup>77</sup> Simpson (2017)

Measures adopted by Moscow	Suggested action(s) for Moscow and other aspiring Smart Sustainable Cities
<p>Over the past few years, a bicycle infrastructure has been created in Moscow from scratch. Bicycle racks and bicycle lanes have appeared in the city and a bike-share system was put in place.<sup>78</sup> Cycling in the centre of Moscow is one of the quickest ways to see the city. However, vehicular traffic is still prone to interfere with cyclists in the city centre, where 40% of Moscow's workplaces are located.<sup>79</sup></p> <p>The Department of Transport has ambitious plans to create an eventual 700 km of bike lanes in Moscow, and thousands of bikes are available to use at hundreds of locations as part of the city's bike share scheme.</p> <p>The trend of bike riding for pleasure in the park has grown exponentially since the introduction of bike sharing and new bicycle paths. More importantly, the same Troika card used to pay for other public transport can also be used to rent these bikes. There are now 430 bike share stations in Moscow, offering 43 rides per day to users in 2017 – for a total of 2.4 million rides in 2017. Since inception, 50 new stations and 500 bicycles have been added to the network each year.<sup>80</sup></p> <p>The 210 kilometres of bike paths and lanes that Muscovites currently enjoy correspond to a value of 1.68 kilometres per 100 000 of the city's inhabitants.</p>	<p>It is recommended that aspiring smart sustainable cities similarly invest in building bicycle paths, especially in city centre areas, and developing bike sharing schemes that would allow inhabitants to commute around the city in an affordable and sustainable manner.</p> <p>It should be noted that biking and bike sharing are likely to get a large following in a city only when bicycles are coupled with safety measures and more universal biking facilities.<sup>81</sup> Therefore, a planned and researched approach when investing in such infrastructure and programmes is recommended.</p> <p>Cities that have successfully introduced such initiatives have benefitted from several environmental, social and urban mobility benefits.<sup>82</sup></p>

There are other areas for actions that are recommended for Moscow and aspiring smart sustainable cities:

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<sup>78</sup> Mead (2015)

<sup>79</sup> Simpson (2017)

<sup>80</sup> <https://velobike.ru/en/>

<sup>81</sup> <https://www.smartcitiesdive.com/ex/sustainablecitiescollective/7-reasons-fund-bicycle-infrastructure/268971/>

<sup>82</sup> <https://www.sharetheroad.ca/what-are-the-benefits-to-government-when-they-invest-in-cycling--p128284>

**Greenhouse gas emissions (GHGs)**

*SDG Target 11.6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality, municipal and other waste management.*

*SDG Indicator 13.2.1: Number of countries that have communicated the establishment or operationalization of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production (including a national adaptation plan, nationally determined contribution, national communication, biennial update report or other.*

*The release of GHG emissions into the atmosphere remains a matter of concern for global leaders. Specific targets stipulated in the Paris Agreement, Sustainable Development Goal 13 and the Connect 2020 Agenda are all directed toward lowering GHG emissions. Considering these international instruments, aspiring smart sustainable cities should incorporate relevant policies and standards into their smart city framework to ensure that their transitions will help address global warming and other climate change-related issues. Aspiring smart sustainable cities may also set up e-monitoring systems within their territories and regulate GHG emissions per sector.*

*Monitoring and reporting of GHG emissions per capita (distinct from composite air quality indicators) is recommended for Moscow and other cities interested in smart and sustainable practices.*

*As well, cities are encouraged to make use of Recommendation ITU-T L.1450 on “Methodologies for the assessment of the environmental impact of the information and communication technology sector” and Recommendation ITU-T L.1460 “Connect 2020 greenhouse gases emissions – Guidelines”.*

### **Noise exposure**

*SDG Target 11.6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality, municipal and other waste management.*

*Noise pollution in cities remains a major hazard, with prolonged over-exposure potentially leading to hearing loss, distortion of the sleep cycle and disturbances to animals. In aspiring smart sustainable cities with growing populations, an effective ICT-based noise monitoring system may be required to maintain the tranquility of the urban sphere.*

*Monitoring and reporting of the percentage of inhabitants exposed to excessive noise level is recommended for Moscow and other cities interested in smart and sustainable practices.*

### **Recycling**

*SDG Indicator 11.6.1: Percentage of urban solid waste regularly collected and with adequate final discharge with regard to the total waste generated by the city.*

*Many cities generate more solid waste than can be readily disposed of and the use of open pits to burn waste is still fairly common, which can lead to adverse effects on the environment and health. The following solid waste treatment categories should be prioritized:*

- *Disposal to sanitary landfill is preferable to burning in open areas or disposal in open dumps.*
- *Solid waste recycling in a regulated facility is preferable to burning and dumping.*
  - *Solid waste incineration and energy production is preferable to dumping and burning in open areas.*

*Increasing the percentage of solid waste recycled over all other methods of disposal is recommended for Moscow and other cities interested in smart and sustainable practices.*



## 5.4. Moscow's performance: Society and culture dimension

**100%**

Percentage of students with access to classroom ICTs

**420.8**

Number of physicians per 100 000 inhabitants

**27 881**

Higher level education degrees per 100 000 inhabitants

**462.4**

Number of police officers per 100 000 inhabitants

The KPIs within this dimension focus on the themes of openness, public participation and transparency in governance. KPIs that measure the quality of life of citizens and the extent of ICT implementation in the education, health and safety sectors are also included.

The preceding sections have shown how Moscow has made significant progress in developing the foundation that allows for the creation of electronic platforms for public and private sector use. Such platforms lay the groundwork for more transparent and more efficient governance, and also maintain inclusiveness of city inhabitants, given that stakeholders are pivotal to the city's decision-making processes. They ensure that health, education and safety services are deployed with the least possible disruption, waiting time and manual intervention.

### Health care

Moscow has a high level of health insurance coverage (98.22%) with a large public healthcare system that is integrated with ICT applications. This ICT-based healthcare system contains the health records of 77.60 per cent of Moscow's citizens, and enables the scheduling of doctor's appointments, and the analysis of medical records and images for disease monitoring and outbreak prediction. A key measure of the success in this area is that life expectancy has increased to 78 years, which is above the overall Russian life expectancy.

*This vital integrated health services delivery and insurance system helps Moscow achieve UN SDG Target 3.D: Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks, and SDG Target 3.8: Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all.*

### Public safety

Moscow has one of the highest numbers of CCTV cameras installed in any large global city. There are over 160 000 cameras installed in entrance halls, courtyards, public places and education institutions. Video recordings are used in 70 per cent of police investigations into various crimes in the city and every day, up to 50 000 parking penalties are issued automatically by the cyber security system.

The system's visible presence often acts as a deterrent of violent crimes. In 2017, the city reported only around 54 violent crimes per 100 000 of its inhabitants. This is an important development for Moscow, as the number of violent crimes in a city is considered to be the benchmark for measuring the overall level of safety in a city. Moscow has, in fact, gained international recognition for its advanced security system in recent years. In a survey conducted

by Frost & Sullivan, Moscow was ranked among the Top 10 cities in the world with the best ICT urban security technology.<sup>83</sup>

The visible presence of cameras also helps to regulate traffic accidents. This is reflected, for example, in the low number of traffic fatalities in the city (3.95 per 100 000 inhabitants). Crimes and misdemeanors are contained by the city's prevalent police presence, with 462.4 police officers per 100 000 inhabitants.

As part of a pilot project by the blockchain team, recordings are kept at the Single Data Storage and Processing Centre, which utilizes blockchain technology. The immutable nature of blockchain technology has made the recordings contained in the Processing Centre secure and unlikely to be altered illegally. Any archived information is kept for a total of five days. In cases of emergency, it is possible to retain the archived information from the camera for up to 30 days by calling a central phone number. The application number for the video recording received from the operator during the call must then be given to law enforcement officers or legal counsel. As an additional benefit, the same cameras help to keep an eye on utility services such as monitoring to determine if garbage has been picked up by private contractors as per contract performance measures.

*Efficacy of this integrated video monitoring and security system and the vital data it produces helps Moscow meet the UN SDG Target 16.1: Significantly reduce all forms of violence and related death rates everywhere, and report into SDG Indicator 16.3.1: Proportion of victims of violence in the previous 12 months who reported their victimization to competent authorities or other officially recognized conflict resolution mechanisms.*

Figure 36 illustrates the architecture and users of Moscow's high-tech safety surveillance system. Figure 37 highlights the future plans for Moscow's surveillance systems.

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<sup>83</sup> Athar (2017).

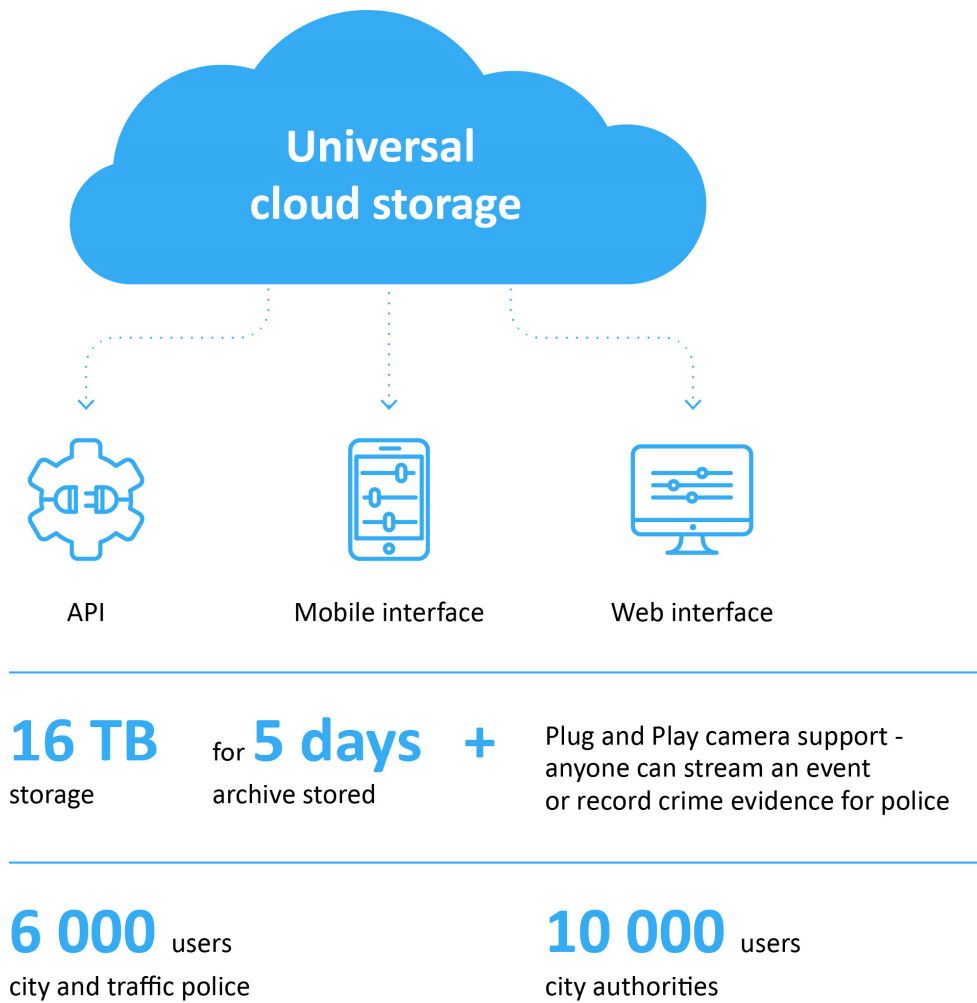


Figure 36: Architecture of Moscow's surveillance system

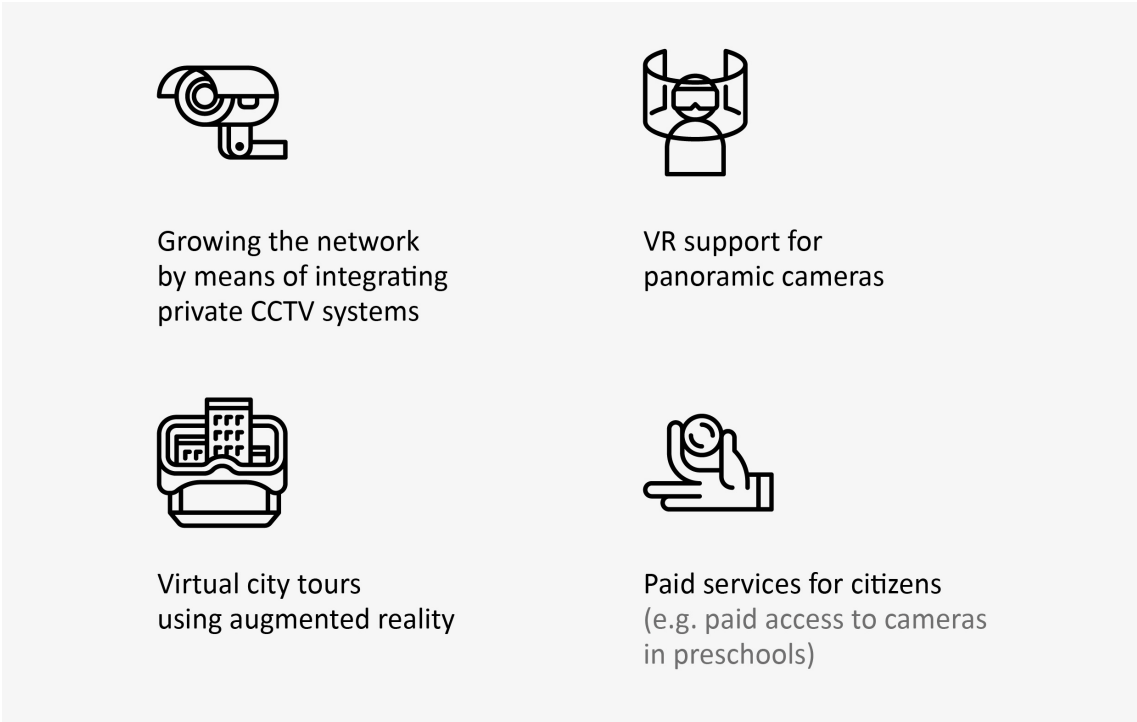


Figure 37: Future plans for Moscow's surveillance system

## Education

Moscow's cloud-based educational platform is connecting more than 900 000 pupils, 65 000 teachers and 773 schools to a single platform. It is the largest e-learning project in the world. Its educational content library contains 44 000 lesson scenarios and 542 000 content units, i.e. textbooks, assignments, tests, presentations and videos. One hundred per cent of Moscow's students have classroom access to ICT facilities. The city's investment in its education systems and institutions is also reflected in other KPIs. Moscow boasts an adult literacy rate of 99.96 per cent, with 27 881 higher-level education degrees per 100 000 of the city's inhabitants and 95.4 per cent of its school-age population enrolled in public schools.

## Culture

Moscow is a historic European city with a vibrant and modern culture. Moscow's government currently spends 2.46 per cent of its annual budget on supporting the city's cultural heritage and maintaining its cultural institutions (which number 74.84 per 100 000 inhabitants).

## Preparedness and resilience

Disaster and emergency response and mitigation are also key resilience factors in a city's environmental sustainability. Moscow has not suffered from any major natural disasters in recent years, and consequently, its natural disaster-related economic losses remain low, at 0.007 per cent of GDP; and the city recorded 0.13 natural disaster related deaths per 100 000 inhabitants.

However, its emergency response resources remain sound, with 100 full-time firefighters per 100 000 of the city's inhabitants and an average response time from an initial call to the on-site arrival of emergency services of 3.17 minutes.

Also contributing to Moscow's overall resilience and sustainability is food security. No less than 10.74 per cent of local food is being supplied from within 100 kilometres of the city's urban area. Further efforts to produce and source local foods will benefit the city in the future.

The following list summarizes the key measures adopted by Moscow within the U4SSC Society and Culture dimension and offers further suggestions for other aspiring Smart Sustainable Cities, as well as Moscow.

**0.73**

Gender Income Equity  
(Female to Male)

**0.42**

Income Distribution  
(Gini Coefficient)

Measures adopted by Moscow	Suggested action(s) for Moscow and other aspiring Smart Sustainable Cities
The Moscow online school, cloud-based educational platform, connects 900 000 pupils, 65 000 teachers and 773 schools. It is the largest e-learning project in the world. Its educational content library contains 44 000 lesson scenarios and 542 000 content units, i.e. textbooks, assignments, tests, presentations and videos.	Urban stakeholders are encouraged to adopt compulsory e-learning systems for students, and foster public-private partnerships that will invest in the city's schools as a way of developing a future economic labour force that is ICT literate.

Measures adopted by Moscow	Suggested action(s) for Moscow and other aspiring Smart Sustainable Cities
<p>Moscow's investments in e-learning and revitalizing existing infrastructure have approximated to be around 300 million US dollars between 2017-2018 (e.g. Wi-Fi access in every classroom, 81-inch-wide interactive panels instead of whiteboards and 100 Mbps broadband channels in all schools).</p> <p>The results are that academic progress has grown by 15%, while the implementation of Smart School administration has resulted in 88% cost savings.</p> <p>Future plans include the following:<sup>84</sup></p> <ul style="list-style-type: none"> <li>• All schools will be provided with tablets, interactive whiteboards, and digital checkpoint systems for pupils and teachers.</li> <li>• 100% of schoolbooks and additional materials will be uploaded to a digital platform.</li> <li>• Further implementation of virtual reality (VR) and augmented reality (AR) technologies to enrich learning experiences at schools.</li> </ul>	<p>To achieve this, a planned, integrative approach to education from the government's education department and technology departments is recommended. This requires educators to "find ways of integrating learning into the (ultimate) workplace, and not just see ICT as a course undertaken separately in preparation for the Knowledge Society and economy". (McNair, 2001)<sup>85</sup></p> <p>Meanwhile, public schools' spending on ICT must also be regularly reviewed &amp; updated as it is key component of a city's budget and overall technology management plan.</p>
<p>Moscow's e-governance and e-engagement systems such as Active Citizen and Our City, are part of a larger integrated system in which data from different sensors, meters and cameras, and other sources, is collected and analyzed to gauge different situations in the city. Combining this data with data and input received directly from the citizens, they illustrate citizens' concerns which allows the city government to respond and act accordingly.</p> <p>This is made possible by Moscow's well-established cyber security system, which covers all aspects of the broader Moscow IT systems. Cybersecurity is extremely important for all e-government services, because if one part of the system is compromised, then that can weaken the rest of the system.</p>	<p>Urban governments and stakeholders are recommended to take a planned, integrative approach to e-governance, e-engagement and e-service systems for their cities, in order to make investments that will yield the most positive impacts for their city's inhabitants.</p> <p>This planned approach is important in enabling the technical challenges and social barriers in implementing e-services to be overcome. A planned approach can help to manage the high cost (i.e. financial challenges) of ICT, procurement, implementation, upgrade and maintenance, while meeting the technical challenges related to ICT infrastructure, privacy and security.</p>

<sup>84</sup> Athar (2018)

<sup>85</sup> <https://www.ictesolutions.com.au/blog/why-schools-should-invest-in-ict.aspx>



Measures adopted by Moscow	Suggested action(s) for Moscow and other aspiring Smart Sustainable Cities
All of Moscow's cyber security measures and the associated cyber-monitoring systems (safety, utility, transport, etc.) share the same goal: to improve the quality of life in the city by creating comfort and safety for the citizens, reducing traffic congestion, creating green areas, building smart infrastructure and revitalizing public transport.	Organizational challenges, such as top management support, resistance to electronic solutions, the challenges of working together and the lack of qualified personnel and training are also common, along with social challenges such as culture and the digital divide. <sup>86</sup>  All these must be considered by any city looking to implement e-governance.

*Moscow's e-learning and electronic school services help report into two important UN indicators - SDG Indicator 4.4.1: Percentage of youth/adults with information and communication technology (ICT) skill by type of skill, and SDG Indicator 4.a.1: Proportion of schools with access to: (b) the Internet for pedagogical purposes; (c) computers for pedagogical purposes, and can help showcase the city's commitment to fulfilling SDG Target 5.B: Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women.*

*Moscow's e-services contribute towards its meeting the UN SDG Target 16.6: Develop effective, accountable and transparent institutions at all levels, and SDG Target 16.7 Ensure responsive, inclusive, participatory and representative decision-making at all levels.*

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<sup>86</sup> Alshehri et al. (2010).

There are other areas for actions that are recommended for Moscow and aspiring smart sustainable cities:

**Voter participation**

*SDG Target 16.7: Ensure responsive, inclusive, participatory and representative decision-making at all levels.*

*SDG Target 11.3: By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.*

*SDG Indicator 11.3.2: Proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically.*

*A high voter participation is a sign that a city's political system enjoys a strong degree of participation. Civic engagement and the opportunity for people to express their own political views are basic freedom rights of effective democracies. Engaging people in decision making improves the quality and the inclusiveness of the decisions. It also helps improve on the existing laws and regulations.*

*A high percentage is desirable in a democracy because it increases the chance that the political system reflects the will of a large number of individuals, and that the government enjoys a high degree of legitimacy.*

*Many cities around the world experience low voter turnouts in municipal or local elections. It is, therefore, important for all cities, including Moscow that reported 32% as the eligible population that voted during the last municipal election, to encourage citizen participation and counteract any barriers citizens may face in their voting efforts.*

**Gender income equity**

*SDG indicator 8.5.1: Average hourly earnings of female and male employees, by occupation, age group and persons with disabilities.*

*This indicator is defined as unadjusted (e.g. not adjusted according to differences in individual characteristics or other observable characteristics that may explain part of the earnings difference) because it gives an overall picture of gender discrimination and the inequalities in the labour market that explain gender differences in pay. A value of one (1) indicates equality.*

*A trend of closing the income gap is considered positive.*

*Most cities, developed and developing alike, have yet to achieve parity between genders when it comes to income. Moscow reports a female to male income ratio of 0.73. Therefore, policies and efforts aimed at reducing the income gap between genders is highly recommended for Moscow and all other aspiring smart sustainable cities.*

## **5.5. Improvements for implementing the U4SSC KPIs on SSC**

Moscow's project was, in part, intended to help the U4SSC KPIs revision process. It is only through the dedicated efforts of the stakeholders in Moscow and their honest feedback on their experience in implementing the KPIs that, the strengths and weaknesses of each KPI can be identified and that the existing data collection and verification processes can be improved.

Continuously updating the definitions and collection methodologies for each KPI will help cities to better identify the data source and ensure that the data collected are easily verifiable and comparable against their global peers. Data collected through this process will help improve data quality, which will in turn facilitate credible input into ITU's upcoming Global Smart Sustainable Cities Index (see Box 2 for details).

The Moscow government and its departments and agencies have provided not only the required data for the U4SSC KPIs, but also valuable feedback on the clarity and effectiveness of each indicator and the ease of implementing them. The feedback received for each KPI has given ITU a better understanding of the scope of each KPI and its contribution to achieving the Smart Moscow 2030 strategy.

Both Moscow and ITU recognize that there is room for improvement in the KPIs. To this end, Moscow has suggested improving the clarity of the definitions of the KPIs, in order to help cities to pinpoint the data sources needed for the KPIs and revise the collection methodologies.

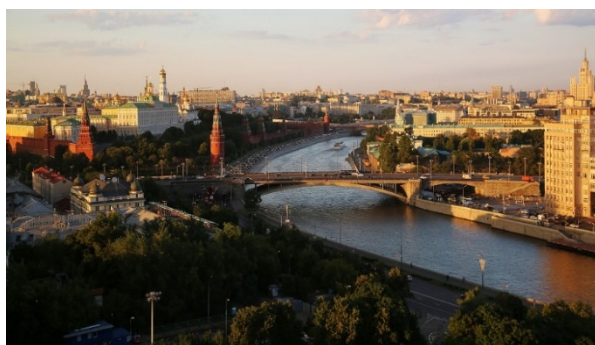
## **5.6. Potential additional U4SSC KPIs on SSC**

Moscow has also proposed the following potential new KPIs that would enhance the participating city's profile generated through the reporting of the KPIs:

1. Average cost of housing / average salary:
  - This indicator could provide information about the affordability of housing in a city.
  - High prices for real estate are a serious problem that affects the ability of future generations to participate fully in a city's economy. How cities address this issue affects their long-term sustainability.

2. Volume of online transactions / volume of operations for cash:
  - An additional measure of how highly developed the infrastructure is for e-commerce and how open citizens are to transition to a more digital-based economy.
3. Changes in average salary year over year:
  - A measure of personal economic growth that can then be related to the city's inflation rate.
  - Growth in average salary is the hallmark of an improving economy and development of the labour market of a city, but in the case of high inflation, real growth may not be as optimistic as initially thought.

## Conclusion



**Figure 38: City of Moscow during daytime**

Moscow served as an ideal testing partner for the implementation of the KPIs developed by the U4SSC for Smart Sustainable Cities, given the city's defined Information City and Smart Moscow 2030 strategies to transition into a fully smart and sustainable city in the coming years. Through the lens of its Information City vision, Moscow has its citizens living, working, playing and interacting.

This is the first year of Moscow's close working relationship with ITU on this project designed, in part, to continue the evaluation of the feasibility of the U4SSC KPIs. It comes at a pivotal moment in the city's history as a smart sustainable city, as the current Information City strategy is set to make way for the new Smart Moscow 2030 from the beginning of 2019. This venture is, therefore, timely for Moscow's continuing development and refinement of the new strategy, and is expected to make a valuable contribution to this.

The following conclusions (subject to change) have been derived based on Moscow's experience:

- As a part of the U4SSC KPIs refinement process, ITU undertook a two-part approach to the indicators by preparing a basic set of core KPIs that can be reported easily by most cities, along with a list of advanced KPIs. The advanced KPIs can normally only be reported by cities with more advanced programmes related to smartness and sustainability. The ability of Moscow to report on most advanced KPIs shows that the city is in an advanced stage of development towards becoming smarter and more sustainable.
- Moscow has concluded all three phases of the project. The Smart City Lab in Moscow has provided valuable feedback on the U4SSC KPIs and proposed three potentially new KPIs to be added to the set (See Section 5.6). These would improve the usability and applicability of the U4SSC KPIs by better reflecting the different facets of the participating city and by improving the city profile generated through reporting the KPIs. This will benefit Moscow and potentially other cities in Russia and CIS countries in the future.
- ICTs are a known key contributor to the Moscow economy. Building on its strengths and maintaining ICTs as a strategic lever, Moscow has adopted vibrant policies for ICT development and proliferation. This has helped to establish a sound foundation upon which to establish a smart and sustainable city. With its effective public policies and initiatives in fostering ICT adoption, Moscow has become a leading city in ICT-readiness and e-government performance within the Commonwealth of Independent States (CIS), Europe and globally. These aspects are clearly reflected in the good performance by Moscow within the U4SSC KPI sub-dimensions of "ICT" and "Productivity".
- Despite having made significant progress in the U4SSC KPI sub-dimensions of "ICT", "Productivity" and "Equality and Social Inclusion", Moscow should continue to divert more efforts toward the sub-dimension of "Environment", in order to drive sustained reduction in greenhouse gas emissions (GHGs), promote noise-based monitoring systems and improve public perception of the capital's surroundings.



- Developing and implementing two clear, vision-based smart sustainable strategies (Information City and Smart Moscow 2030) with the essential governmental support and political backing at all levels has been a major success factor in Moscow's rapid smart sustainable progress to-date.
- Strategic consolidation of its IT functions, cohesive change management strategies, enablement of centralization of its delivery, monitoring and reporting platforms, and an overall innovative approach – which, for example, allows the Smart City Lab to run experimental pilot projects – are also key success factors identified for Moscow in this case study.
- It is imperative that Moscow continues to foster and take advantage of public and private partnerships in increasing the number of, and enhancing the efficacy of, the city's ICT-based solutions. Moscow's ability to attract direct investment will be symbiotic to its ability to continually elevate its technological profile in every area.
- Moscow and other aspiring smart sustainable cities should implement the best practices discussed in this case study, in order to improve the applicability of the KPIs in their country and accelerate the achievement of their smart sustainable city goals in line with international instruments, including the Paris Agreement, Connect 2020 Agenda, the Sustainable Development Goals (SDGs) and the New Urban Agenda.
- After the creation of the first Global Smart Sustainable Cities Index by ITU, Moscow should utilize the index to measure its progress in reaching the SDGs and how it compares to other cities.

## References

- Alshehri, Mohammed, and Steve Drew. "Implementation of e-Government: Advantages and Challenges." Griffith University. 2010. [www.academia.edu/1007717/Implementation\\_of\\_e-Government\\_Advantages\\_and\\_Challenges](http://www.academia.edu/1007717/Implementation_of_e-Government_Advantages_and_Challenges).
- Akyuz, Emrah. "The Solutions to Traffic Congestion in Istanbul." The Journal of Academic Social Sciences. 2015. (16. 442-449. 10.16992/ASOS.792).
- Anderson, Martin. "Moscow to Track Cell-Phone Users in 2015, to Aid Traffic Analysis." The Stack, CloserStill Media Ltd. 20 Jan. 2015. <https://thestack.com/security/2015/01/20/moscow-to-track-cell-phone-users-in-2015-to-aid-traffic-analysis>.
- Andrews, Jonathan. "Moscow to Test and Integrate New Smart City Technologies." Cities Today, PDF Media Group. 23 Mar. 2017. <https://cities-today.com/moscow-to-test-and-integrate-new-smart-city-technologies/>.
- Athar, Khalid. "Smart City and ICT Policy in Moscow." Information Policy. 3 Feb. 2018. [www.i-policy.org/2018/02/smart-city-and-ict-policy-in-moscow.html](http://www.i-policy.org/2018/02/smart-city-and-ict-policy-in-moscow.html).
- Bloomingrock. "7 Reasons to Fund Bicycle Infrastructure." Smart Cities Dive, Industry Dive. 2018. [www.smartcitiesdive.com/ex/sustainablecitiescollective/7-reasons-fund-bicycle-infrastructure/268971/](http://www.smartcitiesdive.com/ex/sustainablecitiescollective/7-reasons-fund-bicycle-infrastructure/268971/).
- Centre for Cities. "Cities, Small Businesses and 'New Work'." 19 Oct. 2015. [www.centreforcities.org/reader/small-business-outlook-2015/cities-small-businesses-and-new-work/](http://www.centreforcities.org/reader/small-business-outlook-2015/cities-small-businesses-and-new-work/).
- Coward, Jeremy. "Moscow Is One of Europe's Smart City Trailblazers." IoT Institute, Informa USA, Inc. 11 Apr. 2017. [www.ioti.com/smart-cities/moscow-one-europes-smart-city-trailblazers](http://www.ioti.com/smart-cities/moscow-one-europes-smart-city-trailblazers).
- Dave, Sandeep, et al. "Sustainable Urbanization: The Role of ICT in City Development." Strategy&, PwC. 5 Aug. 2010. [www.strategyand.pwc.com/reports/sustainable-urbanization-role-city-development](http://www.strategyand.pwc.com/reports/sustainable-urbanization-role-city-development).
- Deloitte. "The Importance of a Smart ICT Infrastructure for Smart Cities." Jan. 2017, [www.stokab.se/Documents/Nyheter%20bilagor/SmartCityInfraEn.pdf](http://www.stokab.se/Documents/Nyheter%20bilagor/SmartCityInfraEn.pdf).
- Downs, Anthony. "Traffic: Why It's Getting Worse, What Government Can Do." The Brookings Institution. 3 July 2018. [www.brookings.edu/research/traffic-why-its-getting-worse-what-government-can-do/](http://www.brookings.edu/research/traffic-why-its-getting-worse-what-government-can-do/).
- Field, Tim, et al. "The E-Government Imperative." Vol. 2003. OECD Publishing. 2004.
- Girardi, Chiara. "Moscow – Energy Efficient City, 2017." Build Up: The European Portal for Energy Efficiency in Buildings. 27 Jun. 2017. [www.buildup.eu/en/events/moscow-energy-efficient-city-2017-xxxiv-conference-and-exhibition](http://www.buildup.eu/en/events/moscow-energy-efficient-city-2017-xxxiv-conference-and-exhibition).
- ICTE Solutions Australia. "Why Schools Should Invest in ICT." 2018. [www.ictesolutions.com.au/blog/why-schools-should-invest-in-ict.aspx](http://www.ictesolutions.com.au/blog/why-schools-should-invest-in-ict.aspx).
- International Telecommunication Union. "ITU-T, Smart Sustainable Cities at a Glance." [www.itu.int/en/ITU-T/ssc/Pages/info-ssc.aspx](http://www.itu.int/en/ITU-T/ssc/Pages/info-ssc.aspx).
- International Telecommunication Union. "KPIs on Smart Sustainable Cities." [www.itu.int/en/ITU-T/ssc/Pages/KPIs-on-SSC.aspx](http://www.itu.int/en/ITU-T/ssc/Pages/KPIs-on-SSC.aspx).

- Kolm, Barbara. "Global Smart Sustainable City Index (SSC Index): The Global City Ranking." International Telecommunication Union. 26 Apr. 2018. [www.itu.int/en/ITU-T/ssc/201804/Documents/U4SSC%20BK.pdf](http://www.itu.int/en/ITU-T/ssc/201804/Documents/U4SSC%20BK.pdf).
- Kozlov, Vladimir. "Moscow to Build on Its Smart City Credentials." ComputerWeekly.com. 27 Nov. 2017. <https://www.computerweekly.com/news/450430676/Moscow-to-build-on-its-smart-city-credentials>.
- Kötter, Theo & Friesecke, Frank. "Developing urban Indicators for Managing Mega Cities." 2009.
- Kuznetsov, Nikolai. "Moscow is on its Way to Becoming a Smart City and Fintech Powerhouse." Forbes Magazine. 15 Nov. 2017. [www.forbes.com/sites/nikolaikuznetsov/2017/11/15/moscow-is-on-its-way-to-becoming-a-smart-city-and-fintech-powerhouse/](http://www.forbes.com/sites/nikolaikuznetsov/2017/11/15/moscow-is-on-its-way-to-becoming-a-smart-city-and-fintech-powerhouse/).
- Martinidis, George. "Moscow Rapidly Transforming into a Smart City." Urban and Regional Innovation Research (URENIO) and Intelspace Innovation Technologies S.A. (Intelspace). 22 Nov. 2017. [www.urenio.org/2017/11/22/moscow-rapidly-transforming-smart-city/](http://www.urenio.org/2017/11/22/moscow-rapidly-transforming-smart-city/).
- Mead, Nick Van. "Can Traffic-Choked Moscow Become a More Cycle-Friendly City?" The Guardian. Guardian News and Media. 11 Jun. 2015. [www.theguardian.com/cities/2015/jun/11/can-traffic-choked-moscow-become-a-more-cycle-friendly-city](http://www.theguardian.com/cities/2015/jun/11/can-traffic-choked-moscow-become-a-more-cycle-friendly-city).
- McCaskill, Steve. "Wi-Fi and 4G Upgrades Keep Moscow Connected during 2018 World Cup." TechRadar. Future Plc. 24 Aug. 2018. [www.techradar.com/news/wi-fi-and-4g-upgrades-keep-moscow-connected-during-2018-world-cup](http://www.techradar.com/news/wi-fi-and-4g-upgrades-keep-moscow-connected-during-2018-world-cup).
- Moscow City Web Site. "About Moscow - A Glimpse into History". [www.mos.ru/en/city/about/](http://www.mos.ru/en/city/about/).
- Moscow City Web Site. "Active Citizen: The Best Votes of 2017." 19 Jan. 2018. [www.mos.ru/en/news/item/34873073/](http://www.mos.ru/en/news/item/34873073/).
- Moscow City Web Site. "All Moscow Parks to Be Improved by End of 2018." 22 Jul. 2017. [www.mos.ru/en/news/item/26936073/](http://www.mos.ru/en/news/item/26936073/).
- Moscow City Web Site. "City to Establish over 50 New Parks in 2017." 19 Jan. 2017. [www.mos.ru/en/news/item/19928073/](http://www.mos.ru/en/news/item/19928073/).
- Moscow City Web Site. "Information City: Plans for 2017." 6 Apr. 2017. [www.mos.ru/en/news/item/22489073/](http://www.mos.ru/en/news/item/22489073/).
- Moscow City Web Site. "Information Technologies in the Sphere of Housing and Communal Services." [www.mos.ru/city/projects/jkh](http://www.mos.ru/city/projects/jkh).
- Moscow City Web Site. "In the center by bus: The second line of the route network 'Magistral'." <https://www.mos.ru/city/projects/magistral/>.
- Moscow City Web Site. "Investment in Moscow Grows 70 Percent in Seven Years." 15 Feb. 2018. [www.mos.ru/en/news/item/36584073/](http://www.mos.ru/en/news/item/36584073/).
- Moscow City Web Site. "Meeting of the Connected Cities 2020 Urban Leaders' International Club Held in Moscow." 24 May 2018. [www.mos.ru/en/news/item/40697073/](http://www.mos.ru/en/news/item/40697073/).
- Moscow City Web Site. "Merging Reality and VR." [www.mos.ru/en/city/projects/smartcity/](http://www.mos.ru/en/city/projects/smartcity/).
- Moscow City Web Site. "Metro to Start Selling Troika Bracelets and Rings in Late October." 11 Oct. 2017. [www.mos.ru/en/news/item/30579073/](http://www.mos.ru/en/news/item/30579073/).

- Moscow City Web Site. "Moscow Drives Country's Economic Development." 4 Feb. 2018. [www.mos.ru/en/news/item/36036073/](http://www.mos.ru/en/news/item/36036073/).
- Moscow City Web Site. "Moscow Residents Vote for Key 2017 Projects." [www.mos.ru/en/city/projects/vybor-moskvichey/](http://www.mos.ru/en/city/projects/vybor-moskvichey/).
- Moscow City Web Site. "Over 35 Public Spaces Have Been Improved around Moscow." 24 Oct. 2017. [www.mos.ru/en/news/item/31251073/](http://www.mos.ru/en/news/item/31251073/).
- Moscow City Web Site. "Relaunching the Information Sector: New Opportunities for Small Business." 29 May 2018. [www.mos.ru/en/news/item/40739073/](http://www.mos.ru/en/news/item/40739073/).
- Moscow City Web Site. "Sergei Sobyenin: 95 Percent of City Residents to Get Neighbourhood Metro Stations." 13 Feb. 2018. [www.mos.ru/en/news/item/36365073/](http://www.mos.ru/en/news/item/36365073/).
- Moscow City Web Site. "This Year over 1,000 4G Base Stations Have Been Installed in Moscow." 27 July 2017. [www.mos.ru/en/news/item/27053073/](http://www.mos.ru/en/news/item/27053073/).
- Moscow City Web Site. "What Will Moscow Become in the Digital Future? Muscovites Will Choose the Most Useful Technology for Their Capital." 2 Aug. 2018. [www.mos.ru/en/news/item/43349073](http://www.mos.ru/en/news/item/43349073/).
- Moscow Urban Forum. "Age of Agglomerations. Rethinking the World Map." Archive 2017. [www.mosurbanforum.com/2017/](http://www.mosurbanforum.com/2017/).
- OECD. "Implementing E-Government in OECD Countries: Experiences and Challenges (Background Paper)." [www.oecd.org/mena/governance/36853121.pdf](http://www.oecd.org/mena/governance/36853121.pdf).
- OECD. "OECD Broadband Statistics Update." [www.oecd.org/sti/broadband/broadband-statistics-update.htm](http://www.oecd.org/sti/broadband/broadband-statistics-update.htm).
- Paiho, Satu, et al. "Energy-Efficient Renovation of Moscow Apartment Buildings and Residential Districts." VTT Technology 82. 2013. [www.vtt.fi/inf/pdf/technology/2013/T82.pdf](http://www.vtt.fi/inf/pdf/technology/2013/T82.pdf).
- Russia Today. "Moscow Schools Will Install Wi-Fi in Each Class." RIA Novosti. 30 Oct. 2017. <https://ria.ru/society/20171030/1507808544.html>.
- Share the Road Cycling Coalition. "What Are the Benefits to Government When They Invest in Cycling?" 2018. [www.sharetheroad.ca/what-are-the-benefits-to-government-when-they-invest-in-cycling--p128284](http://www.sharetheroad.ca/what-are-the-benefits-to-government-when-they-invest-in-cycling--p128284).
- Simpson, Paul. "City Profile - Moscow." Smart Cities World. 2 Oct. 2017. [www.smartcitiesworld.net/opinions/smart-cities-reports/smartcitiesworld-city-profile--moscow-full-report](http://www.smartcitiesworld.net/opinions/smart-cities-reports/smartcitiesworld-city-profile--moscow-full-report).
- Smiciklas, John, et al. "Implementing ITU-T International Standards to Shape Smart Sustainable Cities: The Case of Singapore." International Telecommunication Union. Nov. 2017. [www.itu.int/en/publications/Documents/tsb/2017-Implementing-ITU-T-International-Standards-to-Shape-Smart-Sustainable-Cities-The-Case-of-Singapore/mobile/index.html](http://www.itu.int/en/publications/Documents/tsb/2017-Implementing-ITU-T-International-Standards-to-Shape-Smart-Sustainable-Cities-The-Case-of-Singapore/mobile/index.html).
- Stivers, Valerie. "Moscow's Makeover Swaps Soviet Grit for Urban Sparkle." Bloomberg Businessweek, 10 Aug. 2017. [www.bloomberg.com/news/features/2017-08-10/moscow-s-makeover-swaps-soviet-grit-for-urban-sparkle](http://www.bloomberg.com/news/features/2017-08-10/moscow-s-makeover-swaps-soviet-grit-for-urban-sparkle).
- Tkatchuk, Ralph. "How Moscow Is Pioneering the Rise of Smart Cities." CIO.com. IDG Communications, Inc. 6 Nov. 2017. [www.cio.com/article/3236154/digital-transformation/how-moscow-is-pioneering-the-rise-of-smart-cities.html](http://www.cio.com/article/3236154/digital-transformation/how-moscow-is-pioneering-the-rise-of-smart-cities.html).
- Treasury Board Secretariat of Canada. "Open Data 101 | Open Government." Government of Canada. 19 Dec. 2017. <https://open.canada.ca/en/open-data-principles>.

- Úbeda, Reyna. "ITU Transforming Cities in Smarter and More Sustainable." International Telecommunication Union. 26 Apr. 2018.  
[www.unece.org/fileadmin/DAM/hlm/Meetings/2018/04\\_26/Documentation/4\\_02\\_Reyna\\_Ubeda.pdf](http://www.unece.org/fileadmin/DAM/hlm/Meetings/2018/04_26/Documentation/4_02_Reyna_Ubeda.pdf).
- United Nations Public Administration Network. "UN E-Government Survey 2016: E-Government in Support of Sustainable Development." 2016.  
<https://publicadministration.un.org/egovkb/en-us/Reports/UN-E-Government-Survey-2016>.
- United Nations, Department of Economic and Social Affairs, Population Division. "World Urbanization Prospects: The 2014 Revision." 2015 (ST/ESA/SER.A/366).
- United Nations, Department of Economic and Social Affairs, Population Division. "The World's Cities in 2016 – Data Booklet." 2016 (ST/ESA/SER.A/392).
- Velobike | Moscow Bike sharing, CityBike. 2018. <https://velobike.ru/en/>.
- Weiss, Lior. "The Connected City and the Future of Free Wi-Fi." Wired, Conde Nast. 7 Aug. 2015. [www.wired.com/insights/2014/06/connected-city-future-free-wi-fi/](http://www.wired.com/insights/2014/06/connected-city-future-free-wi-fi/).
- World Bank. "Dynamics of Cities as Engines of Growth". World Development Report. 1999/2000.
- World Bank. "Urban Development | Overview."  
[www.worldbank.org/en/topic/urbandevelopment/overview](http://www.worldbank.org/en/topic/urbandevelopment/overview).











**International  
Telecommunication  
Union**

Place des Nations  
CH-1211 Geneva 20  
Switzerland  
[www.itu.int](http://www.itu.int)

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