United **4** Smart Sustainable Cities

Factsheet
Riyadh, Saudi Arabia

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الهيئة الملكية لمدينة الرياض
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ITU

Factsheet

Riyadh, Saudi Arabia

Foreword

This publication has been developed within the framework of the United for Smart Sustainable Cities (U4SSC) initiative. It provides an overview of the reporting and implementation of key performance indicators (KPIs) for smart sustainable cities (SSC) in the City of Riyadh, Saudi Arabia. This set of KPIs for SSC were developed to establish the criteria to evaluate ICTs' contributions in making cities smarter and more sustainable, and to provide cities with the means for self-assessments.

Acknowledgements

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This publication is intended for informational purposes only. The results and interim findings presented are a work in progress, as the KPIs (ITU-T Recommendation Y.4903/L.1603) implemented in Riyadh during the first phase of the project are being refined to improve the applicability of these KPIs to all cities. The revision of the KPIs may alter their scope and definition as well as the required data collection process.

This publication is based on the project conducted in Riyadh in 2019.

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Abbreviations

ADA	Arriyadh Development Authority
AMI	Advanced Metering Infrastructure
CO_2	Carbon Dioxide
DER	Distributed Energy Resources
DRR	Disaster Risk Reduction
HER	Electronic Health Records
EV	Electric Vehicles
GDP	Gross Domestic Product
GHG(s)	Greenhouse Gas Emission(s)
GIS	Geographic Information System
GW	Gigawatts
ICE	Internal Combustion Engine
ICTs	Information and Communications Technologies
IoT	Internet of Things
ITS	Intelligent Transport System
ITU	International Telecommunication Union
KACST	King ʿAbd al-ʿAzīz City for Science and Technology
KPI(s)	Key Performance Indicator(s)
NDVI	Normalized Difference Vegetation Index
NO_2	Nitrogen Dioxide
NWC	Saudi Arabia's National Water Company
O_3	Ozone
OECD	Organization for Economic Co-operation and Development
PHEV	Plug-In Hybrid Electric Vehicle
PM	Particulate Matter ($_{2.5}$ and $_{10}$)
R&D	Research and Development
RD&D	Research, Development and Demonstration
RDA	Riyadh Development Authority
SCADA	Supervisory Control and Data Acquisition
SDG(s)	Sustainable Development Goal(s)
SIB	Sustainable and Intelligent Building
SME(s)	Small and Medium Size Enterprise(s)
SO_2	Sulphur Dioxide
SSC	Smart Sustainable City/Cities
U4SSC	United for Smart Sustainable Cities
UGS	Urban Green Space
UN	United Nations
WHO	World Health Organization

Executive Summary

The United for Smart Sustainable Cities (U4SSC) has developed a set of international key performance indicators (KPIs) for Smart Sustainable Cities (SSC) to establish the criteria to evaluate information and communication technologies' contributions in making cities smarter and more sustainable, and to provide cities with the means for self-assessments in order to achieve the sustainable development goals (SDGs). In 2019, Riyadh, Saudi Arabia, piloted these U4SSC KPIs.[1] This Factsheet documents the findings of Riyadh's project:

- It starts by introducing the U4SSC initiative within the context of digitalization and the importance of the standardization of data in fostering smart sustainable city transitions.

- The subsequent sections describe the various smart sustainable city activities adopted by Riyadh, with notable KPIs from the three U4SSC dimensions (Economy, Environment, and Society and Culture) providing a clear picture of Riyadh's efforts in each of these areas.

- The Factsheet also outlines current projects underway, as well as planned future smart, sustainable development projects.

- Since one of the aims of the project was to improve the feasibility and applicability of the KPIs to all cities, Riyadh provided inputs on the existing KPI definitions, along with practical solutions to improve the data collection process. The key findings from this will contribute to the development of the very first 'U4SSC Smart Sustainable Cities Index'.

The results from Riyadh's collection and reporting of data in accordance with the KPIs and the verification process undertaken are summarized in the following table. Key findings taken from across the different areas are highlighted underneath.

	Total	Reported	Verified	% KPIs Verified
Economy				
Core KPIs	23	22	22	96%
Advanced KPIs	22	11	11	50%
Environment				
Core KPIs	12	12	12	100%
Advanced KPIs	5	4	4	80%
Society & Culture				
Core KPIs	19	19	19	100%
Advanced KPIs	10	7	7	70%
Overall				
Core KPIs	54	53	53	98%
Advanced KPIs	37	**22**	22	59%
Total	**91**	**75**	**75**	**82%**

Riyadh: Key Findings from across the KPIs

- To further optimize a *smart, sustainable ICT infrastructure*, Riyadh could utilize related ITU standards, such as Recommendation ITU-T Y.4901/L.1601: 'KPIs related to the use of ICT in smart sustainable cities' and Recommendation ITU-T Y.4902/L.1602: 'KPIs related to the sustainability impacts of ICT in smart sustainable cities'. Also useful are ITU-T L.1400: 'Overview and general principles of methodologies for assessing the environmental impact of ICTs' and ITU-T L.1440: 'Methodology for environmental impact assessment of ICTs at city level'. For the expansion of high-speed broadband, for example, in any rural areas, the ITU-T Recommendations Y.3000 to Y.3499: 'Future networks' can help guide forward-looking implementation. Planning for public networks, including WIFI, can be assisted through use cases found in Recommendations such as ITU-T Y.4113: 'Requirements of the network for the Internet of things'.

- *Public sector KPIs* can be measured and reported so that their performance can be compared to the appropriate benchmarks.

- Riyadh's public sector is its largest employer, employing more than one-third of the city's workforce, and is the source of approximately half of Riyadh's total production of goods and services. The city, therefore, can play an important role in increasing ICT sector employment and investing further to foster *innovation, utilize community resources and drive economic growth*. As Riyadh works on meeting the digital goals of the Saudi Vision 2030 strategy on implementing smart alternatives to unify government services, there is a particular opportunity to create and retain a larger smart workforce locally.

> **Why not help improve quality of life for your citizens or evaluate the urban functionality of your own city by piloting the U4SSC KPIs? Contact us at u4ssc@itu.int to find out more!**

- The city could continue to control its rate of non-revenue water through the employment of best-practice water-loss accounting methods and through policies that mandate conservation of the city's *water resources*. Increasing the number of smart water meters, and recording and reporting data on the implementation of ICTs to monitor its water distribution systems, will also help the city to plan for greater water supply efficiencies.

- Riyadh's *electrical supply management* is effective, with little interruption and the prevalent use of ICTs to monitor the electrical supply systems. The city could also consider rolling out the installation of more smart electricity meters in homes and buildings, and continue progress on implementing the planned demand response and energy storage capability to achieve agile and responsive energy supply management in the future.

- The city could investigate the use of *sustainability certification programmes* for on-going building operations. Riyadh may consider implementing Recommendation ITU-T L.1370 'Sustainable and Intelligent Building Services', and contributing to the development of draft Recommendation ITU-T L.SP_OB 'A methodology for improving, assessing and scoring the sustainability performance of office buildings'.

- For *public transport*, Riyadh has invested heavilty in expanding its public transport network, with the Riyadh Metro project becoming operational in 2020 and state-of-the-art ICT-enabled and enviromentally friendly buses planned. The city could encourage more usage and incentivize vehicle sharing services and carpool programmes as alternatives, along with a greater use of electric vehicles. In the meantime, traffic anti-congestion measures, including adaptive traffic control or prioritazation measures, are in the process of being employed by the city.

- In *urban planning* terms, Riyadh has reportedly implemented four of five principles (compactness, integration, social inclusiveness and resilience to climate change), which makes it a sustainably planned city, although there is still a high reliance on cars and the city could benefit from spatial assessment identifying existing places with high connectivity and plan for more within the city. Creating more pedestrian zones will also help optimize Riyadh's urban planning results. Urban planning can be optimized by creating pedestrian zones and deploying measures to encourage foot traffic.

- An integrated approach to *climate change and air pollution* should be considered to reduce the risks of applying climate change measures with significant negative impacts on air quality. Riyadh could utilize ITU Recommendations such as ITU-T Y.4207: 'Requirements and capability framework of smart environmental monitoring' and ITU-T Y.4700/F.747.2: 'Deployment guidelines for ubiquitous sensor network applications and services for mitigating climate change'. In particular, GHGs can be reduced through following Recommendations such as 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 gas emission guidelines'.

- Across the KPIs for *public space and nature, environmental quality*, green area accessibility can continue to be improved as part of the city's sustainability strategy.

- In *water consumption,* the city can reduce its rates by following water conservation best practices and through the use of conservation technologies and public awareness-raising.

- All cities should prioritize solid *waste recycling* in a regulated facility, or solid waste incineration that leads to energy production, over all other forms of disposal. Increasing recycling rates can form an important part of the city's future sustainability strategy. Best practices such as enhancing, reinforcing public communication and outreach, evaluating contracts, recycling markets and pricing levels, modifying collection techniques, legislating/funding smart recycling and leveraging lessons learned regionally can help optimize waste recycling as can following ITU-T Recommendations such as ITU-T L.1030: 'E waste management framework for countries', amongst others.

- All cities should optimize use of *sustainable energy sources* such as solar, wind, geothermal, hydropower and ocean energy to meet their energy consumption needs and to track their progress by reporting these KPIs. Best practices in energy management can be encouraged through appropriate policies, incentives and procedures. Standards that guide the modernization and optimization of various public energy use sources can be utilized, including, for example, Recommendation ITU-T Y.4458 'Requirements and functional architecture of a smart street light service'.

- Within the Society and Culture dimension, KPIs are widely reached thanks to a high adult literacy rate, positive health-related outcomes and a wide range of national, government-funded cultural offerings. Still, Riyadh can enhance the ICT use in classrooms, and track future progress as part

of its smart sustainability strategy. The maternal mortality rate can also be further examined to determine the factors involved and progress monitored and reported year after year. And the city will benefit from the adoption of planned electronic health records via a unified, cloud-based system in all hospitals as part of the national Vision 2030 strategy.

- Lastly, emergency and fire service response times can be further examined to gauge the best approach for sustained improvement and effectiveness.

- Riyadh should work closely with other cities on its SSC efforts in order to leverage any best practices and their shared experience with developing and instituting smart and sustainable policies and initiatives in the region.

- ITU would like to invite cities around the world to implement the U4SSC KPIs for SSC, enabling the cities to establish clear data-collection methodologies, collect data, and develop goals and targets.

Background: The United 4 Smart Sustainable Cities (U4SSC) Initiative

The United for Smart Sustainable Cities (U4SSC) is a UN initiative created to foster standardization, integration and interoperability of digital technologies within cities to make them smarter and more sustainable.

The initiative has developed a set of international **key performance indicators (KPIs) for Smart Sustainable Cities (SSC)**[2] to establish criteria to evaluate ICTs' contributions to making cities smarter and more sustainable, and to provide cities with the means for self-assessment in the move towards smartness and sustainability.

The aim is to help cities worldwide use technology to serve the best interests of the people and the environment. For this reason environmental aspects as well as socio-economic factors also play a key role in the U4SSC framework.

Helping cities be smarter and more sustainable: The U4SSC KPIs

The U4SSC KPIs offer a common format to report the progress of smart sustainable city strategies. These indicators also enable cities to measure their progress relative to the United Nations Sustainable Development Goals (SDGs).

ITU's objectives for the U4SSC KPIs for SSC project in cities are as follows:

- **Assisting** cities with implementing the KPIs in order to measure and evaluate a city's progress in becoming smarter and more sustainable toward meeting the SDGs within the local context.
- **Learning** from cities' experiences and **sharing** this rich and varied knowledge, insights and feedback to other cities around the world, enabling them to refine their own smart sustainable city strategies.
- **Evaluating** the strengths of this system of KPIs and identifying any areas for improvement, and obtaining practical and actionable feedback toward supporting the international standardization work of ITU-T Study Group 20: Internet of Things and Smart Cities and Communities.
- **Providing** cities with a consistent and standardized method to collect data and measure performance and progress.

The KPIs are categorized into 3 dimensions:

ECONOMY

SOCIETY AND CULTURE

ENVIRONMENT

A further 7 sub-dimensions are:

ICTs

Productivity

Infrastructure

Environment

Energy

Education, Health and Culture

Safety, Housing and Social Inclusion

The KPIs are further subdivided into **core** and **advanced** indicators.

Core indicators are those that all cities should be able to report. They provide a basic outline of the city's smartness and sustainability – higher levels of performance are generally achievable within these KPIs.

Advanced indicators provide a more in-depth view of a city and measure progress on more advanced initiatives.

Details on each indicator are available online in the Collection Methodology for Key Performance Indicators for Smart Sustainable Cities.

Each indicator has been chosen through a process of review and input by international experts and UN agencies, programmes and secretariats to ensure that the data collected supports the SDGs in a local context. City leaders will benefit from these KPIs in terms of strategic planning and the measurement of their cities' progress towards their individual smart sustainable city (SSC) goals. The indicators will enable cities to measure their progress over time, compare their performance with those of other cities, use the data and insights gleaned as policy tools toward informed policy-setting and decision-making and – through analysis and sharing – allow for the dissemination of best practices and set the standards for progress in meeting the SDGs.

Benchmarks and Scoring Methodology

As part of the U4SSC KPI project, benchmarks were developed for most KPIs to develop a reporting framework to demonstrate to cities how their performance could be reported.

The benchmarks were set based on several factors

- Meeting the aligned SDG fully.
- Performance compared to other international and transnational targets (e.g. OECD, European Commission).
- Performance against UN agency goals (e.g., International Telecommunication Union).
- Evaluation of city performance using UN and other international statistical data.
- Performance measured versus leading city performance globally.

Performance to benchmarks were then scored in four ranges for every KPI and data point reported:

- 0 – 33 % of target – 1 pt
- 33 – 66 % of target – 2 pts
- 66 – 95 % of target – 3 pts; and
- 95 + % of target – 4 pts

The scores for each reported KPI and data point were added to give a percentage score for categories, sub-dimensions and dimensions and reported based on the above target scores. KPIs or data points that are not reported or have no benchmarks yet defined were excluded.

Example: Education 4 KPIs

- If all 4 are reported and the scores are 1pt, 3 pts, 4 pts and 1 pt;
  Total score 9 pts. out of 16 = 56.25 % reported as 33 – 66 % of target.
- If only 3 are reported and the scores are 3 pts, 4 pts and 2 pts;
  Total score 9 pts. out of 12 = 75 % reported as 66 – 95 % of target.

U4SSC unique method

The originality of U4SSC's method lies in the fact that it regards ICTs and digital technologies not as an end in themselves, but rather as tools with which to make a meaningful contribution to achieving the SDGs in an increasingly digitalized landscape. Approximately one-third of the U4SSC KPIs concern digitalization (for example, Student ICT Access) and two-thirds primarily concern sustainable development and environmental impact (for example, Noise Exposure). As such, U4SSC forms a necessary bridge between digitalization and sustainable development.

Riyadh and the U4SSC KPI Project

In response to questions on the level of its digital development and sustainability, the **City of Riyadh decided to join this ITU-led project**, utilizing the needs, aims and solutions of the U4SSC. This ambitious project would help Riyadh **measure and compare its degree of digitalization and sustainability.**

Findings from this project are expected to form an SSC development trajectory to which administrators of other municipalities and regions similar in size and capacity to Riyadh will be able to adapt when developing their own smart sustainable strategies. The KPIs will also help demonstrate how Riyadh is progressing in its achievement of the SDGs. The continuation of the project could also assist Riyadh in conducting a periodic internal review of its current ICT-related efforts, thereby allowing the region to benchmark how its ICTs can best be used to monitor and improve its smart city processes and operations. This project can, therefore, play a key role in planning Riyadh's SSC future.

City Profile: Riyadh, Saudi Arabia[3]

City Profile			
Inhabitants	6 506 700	City GDP	USD 144 537 324 484.59
Area	3 115 km^2	Household Income	USD 23 772
Households	1 116 339	Inflation Rate	4 %

Riyadh is the most populous city in the kingdom of Saudi Arabia and the country's capital. It formed from a small, fortified village in the 17th century on desert lands that had long served as a centre for trading caravans traversing various parts of the Arabian Peninsula.

Today, the City of Riyadh comprises several branch municipalities. It houses more than 4 000 mosques, several modern shopping centres and traditional 'souks' (marketplaces). Large-scale construction projects in Riyadh during the second half of the 20th century and early 21st century have created a vibrant, modern and busy metropolis. This includes the extensive Diplomatic Quarter where embassies and the offices of international organizations are located, and the redeveloped Qaṣr Al-Ḥukm (Justice Palace) district that houses most of the central shops. Other important construction or revitalization projects in the last few decades include the Government Centre, King Saʿūd University, the Islamic University of Imam Muḥammad ibn Saʿūd, and the King ʿAbd al-ʿAzīz Historical Centre.

Several 'industrial cities' have also been developed that serve as centres for various businesses and industries. Various banks are also headquartered in the city, including Saudi Arabia's central bank. Almost one-third of Saudi Arabia's factories are located in Riyadh, producing a range of products including machinery, equipment, metallurgical goods, chemicals, construction materials, food, textiles, furniture, and numerous publications.

The U4SSC KPIs for SSC project comes at a timely moment for Riyadh. The city underwent sweeping redevelopment and modernization in 2007, which saw the implementation of nearly 2 000 new projects to improve the city's financial, medical, educational, telecommunications and utilities infrastructures. Therefore, the city is well-positioned to align its further development with the Sustainable Development Goals (SDGs) through becoming a smart sustainable city (SSC).

The first year of Riyadh's U4SSC KPIs for SSC project has concluded successfully with the active support of ITU.

Riyadh and the KPIs: A Snapshot

The following chart provides an overview of how the KPIs are being met. Starting from the centre, the benchmark performance is indicated for: Dimensions, Categories and KPIs.

- 95+ % of Target
- 66 - 95 % of Target
- 33 - 66 % of Target
- Less than 33 % of Target
- No Data or No Target
- Data Reported - No Targets Yet Available

KPI Dimension 1: Economy

The first U4SSC KPIs dimension is Economy. This dimension covers the sub-dimensions of Information and Communication Technologies (ICTs), Productivity and Infrastructure. In the ICTs sub-dimension, the KPIs include those related to a city's ICT infrastructure, water and sanitation, drainage, electricity supply, transport and public sector. These KPIs aim to assess the availability and use of the ICT infrastructure in cities that facilitates smart sustainable city services.

The Productivity sub-dimension includes KPIs related to innovation and employment. 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. These KPIs are also expected to play a pivotal role in assessing a city's adoption of the ICTs that support socioeconomic growth.

The Infrastructure sub-dimension relates to water and sanitation, waste, electricity supply, transport, buildings and urban planning. These KPIs aim to assess the impact of ICTs on city infrastructure, development and sustainability. The key theme assessed by the Economy KPIs is the level of implementation of ICTs. A smart sustainable city (SSC) requires fixed and mobile ICT infrastructures to allow for the deployment of applications that will:

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

There are also KPIs within this dimension that are meant to help analyse the general economic well-being and innovation of a city and to measure the support from ICTs in the process. The following diagram summarizes Riyadh's KPI performance detailing the categories within the Economy dimension against the current U4SSC benchmarks.

ECONOMY
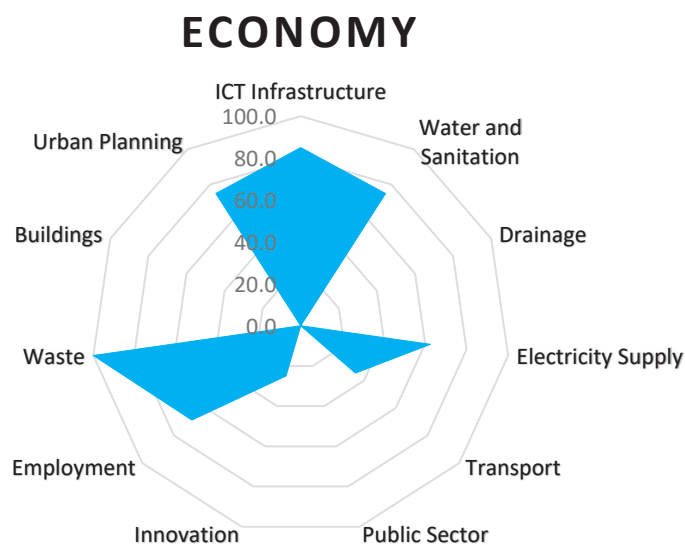
Information and Communication Technology (ICT) Infrastructure

Category	KPI	Result	Performance to Benchmark	SDG
	Fixed Broadband Subscriptions	89.76 %		
	Wireless Broadband Subscriptions (per 100 000 inhabitants)	91 905.27		
	Household Internet Access	73.00 %		
	Wireless Broadband Coverage – 3G	98.97 %		
	Wireless Broadband Coverage – 4G	90.00 %		
	Availability of WiFi in Public Areas	Not Reported	No Benchmark Available	

The reporting of Riyadh's economy starts with its connectivity and ICT infrastructure KPIs.

While the city performs well overall in this category, there is some room for improvement when it comes to internet penetration within households. However, mobile internet access and usage are prevalent in Riyadh, which offsets the lower number for the former.

It is recommended that Riyadh collects data on, and reports, the number of publicly available WiFi spots in the city. Public WIFI can be a great opportunity for governments to connect entire cities. Smart cities deploying free WIFI empower their communities with better services. Municipal services such as smart waste management, smart security and smart lighting can be facilitated through cloud WiFi infrastructures. Equipping public transportation with free WiFi access is another example of how public WiFi positively affects residents and travellers by allowing them to enjoy a better travel experience and the ability get real-time information for route planning. Prevalence of free WiFi hotspots would be advantageous for tourists, who would enjoy internet connection without roaming charges, and for the local economy, which would benefit from increased levels of tourism.

Optimizing smart, sustainable ICT infrastructure: To capture the ICT usage state at that time and to conduct even deeper analysis, Riyadh could utilize related ITU-T standards, such as Recommendation ITU-T Y4901/L.1601: 'KPIs related to the use of ICT in smart sustainable cities' and Recommendation ITU-T Y.4902/L.1602: 'KPIs related to the sustainability impacts of ICT in smart sustainable cities'. Also useful are ITU-T L.1400: 'Overview and general principles of methodologies for assessing the

environmental impact of ICTs' and ITU-T L.1440: 'Methodology for environmental impact assessment of ICTs at city level'.

For expansion of high-speed broadband, the Recommendations ITU-T Y.3000 to Y.3499: 'Future networks' can help guide forward-looking implementation.

Lastly, use cases found in Recommendation ITU-T Y.4113: 'Requirements of the network for the Internet of things' focusing on the transport functions of the network and other service support functions can help in planning for public networks, including WiFi.

For specific ICT Infrastructure projects planned and underway in Riyadh, please see the section on 'Goals and Projects for a Smart Sustainable Future'.

Public Sector

Category	KPI	Result	Performance to Benchmark	SDG
	Open Data Sets Published	Not Reported	No Benchmark Available	
	Open Data Sets Availability	Not Reported		16 PEACE, JUSTICE AND STRONG INSTITUTIONS
	e-Government Services	Not Reported	No Benchmark Available	
	Public Sector e-procurement	Not Reported		

It is recommended that Riyadh collects data for, and reports, the KPIs in this category. The role of e-governance as a building block to a true smart sustainable city has been emphasized by the UN and the OECD. E-governance builds trust between the governments and citizens by involving citizens in the policy process. It makes public services delivery more effective, accessible and responsive to people's needs. Open data and public sector e-procurement help establish government transparency and accountability. E-processes facilitate sharing of information and ideas among various government agencies and departments, leading to higher operational efficiency. Lastly, they save not only resources, effort and money, but also increase service quality levels and reduce the time citizens need to spend dealing with government departments.

Optimizing open data availability: Riyadh may find Recommendations such as ITU-T Y.3600: 'Big data standardization roadmap' particularly helpful when scaling the backend of its e-services and e-processes, along with ITU-T Y.4461: 'Framework of open data in smart cities' when expanding its open data offerings.

Innovation and Employment

Category	KPI	Result	Performance to Benchmark	SDG
	R&D expenditure (relative to GDP)	0.11 %		INDUSTRY, INNOVATION AND INFRASTRUCTURE (9)
	Patents (per 100 000 inhabitants)	8.47		
	Small and Medium-Sized Enterprises (SMEs)	Not Reported		
	Unemployment Rate	6.70 %		DECENT WORK AND ECONOMIC GROWTH (8)
	Youth Unemployment Rate	6.93 %		
	Tourism Sector Employment	10.83 %		
	ICT Sector Employment	0.95 %		

Unemployment levels are relatively low in Riyadh – approximately half of the Saudi Arabian overall unemployment rate of 12.5% (Q1 - 2019).[5] There is also a large disparity between the national unemployment rates among Saudi men (at 6.6%) and Saudi women (at 31.7%). Women across the country are much less likely to enter the workforce than Saudi and women elsewhere in the first place, and face barriers when they do want to enter.

Riyadh's rate of youth unemployment is significantly lower than the national level of 25.8 per cent (2018).[6] This is encouraging when also compared with the broader Middle East and North Africa (MENA) region, where although each country has its own unique circumstances, youth employment is a continuing issue throughout the region, having reached 30 per cent in 2017.[7] In Saudi Arabia, youth unemployment levels in particular are much higher among nationals (at 42%) and young women (at 80% higher than those among young men).[8] Waithood can be a particular issue in the country, where youth often search for years before successfully finding work.

Optimizing innovation, fostering equity and driving growth: Given the above, it is recommended that Riyadh decompose and examine the underlying trends behind its overall youth unemployment KPI and takes steps to mitigate and monitor any concerning underlying trends. Riyadh should, especially, study its unemployment rates disaggregated by gender, and take steps to mitigate and monitor any gaps that it finds.

Riyadh's public sector is its largest employer, employing more than one-third of the city's workforce, and is the source of approximately half of Riyadh's total production of goods and services.⁹ The city, therefore, has an important part to play in increasing ICT sector employment and investing further in R&D and innovation. As Riyadh works on meeting the digital goals of the Saudi Vision 2030 strategy on implementing smart alternatives to unify government services, there is an opportunity to create and retain a larger smart workforce locally. The city benefits from the presence of the King ʿAbd al-ʿAzīz City for Science and Technology (KACST), which carries out research designed to promote the enrichment of Saudi society through technological development. KACST collaborates with several scientific and technological centres around the world on innovative projects, such as the establishment of a national observatory and an aquaculture research centre. Its presence and that of several local universities can be leveraged to develop a pipeline for local technological talent for the city's workforce.

Entrepreneurship and self-employment should also be encouraged further and incentivized, which will lead to the formation of more small and medium-sized enterprises (SMEs) in the city. SMEs are the backbone of any city's economy, regardless of overall business-size mix. A city's continued growth is based, in part, on its ability to promote knowledge-sharing. A wide base of SMEs results in knowledge-intensive economies that can benefit from relationships between firms of related but varied industries which look to reinvent and innovate. The cities that have strengths in these sectors benefit not only from the growth of these industries, but also from the improved productivity in other firms. Therefore, supporting a culture of innovation and technological advancement, especially across its SMEs landscape will help Riyadh's future economic growth. To capture its full current state in this regard, that will enable future benchmarking, it is recommended that Riyadh collects data on and report the number of SMEs that exist in the city.

Water and Sanitation, Drainage and Waste

Category	KPI	Result	Performance to Benchmark	SDG
	Smart Water Meters	77.59 %		
	Water Supply ICT Monitoring	Not Reported		
	Basic Water Supply	100.00 %		
	Potable Water Supply	98.00 %		6 CLEAN WATER AND SANITATION
	Water Supply Loss	22.00 %		
	Wastewater Collection	84.00 %		
	Household Sanitation	84.00 %		
	Drainage/Storm Water System ICT Monitoring	Not Reported		
	Solid Waste Collection	100.00 %		11 SUSTAINABLE CITIES AND COMMUNITIES

While Riyadh's performance is largely positive in these categories, there is room for improvement in some areas, the most notable of which is the city's rate of water loss through the water distribution systems. The high rate warrants evaluation not only due to the age of the distribution infrastructure, but also as an updated examination of any unauthorized withdrawals, billing system data inaccuracies, customer meter errors, etc.

The National Water Company (NWC) is in charge of water supply and sanitation in large Saudi cities such as Riyadh. The company should evaluate where along the distribution infrastructure leaks are occurring, i.e. whether the leaks are more common at or near house/business connections, or elsewhere along the infrastructure.

Optimizing water resources, smartly: To this end, it is recommended that the NWC further optimizes its previously instituted programmes of leak detection and repair, and incorporates best practices in water loss accounting. Increasing the number of smart water meters, and recording and reporting data on the implementation of ICTs to monitor its water distribution systems will also help the city to plan for greater water supply efficiencies.

Riyadh should also report data on its drainage system monitoring.

Several ITU-T Recommendations and Supplements from Y.4000 to Y.4999: 'Internet of things and smart cities and communities' contain guidance on IoT applications and ubiquitous sensor networking, including, for example, Y Suppl. 36: ITU-T Y.4550-Y.4699: 'Smart water management in cities'.

For specific projects already planned and underway, please see the section on 'Goals and Projects for a Smart Sustainable Future'.

Electricity Supply

Category	KPI	Result	Performance to Benchmark	SDG
	Smart Electricity Meters	5.52 %		
	Electricity Supply ICT Monitoring	100.00 %		
	Demand Response Penetration	0.00 %		7 AFFORDABLE AND CLEAN ENERGY
	Electricity System Outage Frequency	1.70		
	Electricity System Outage Time	2.35 Minutes		
	Access to Electricity	100.00 %		

Riyadh's electrical service is effective, with few interruptions, and ongoing monitoring of electricity supply via ICTs.

Optimizing Electrical Supply: Installation of more household smart electricity meters is recommended for Riyadh via a phased roll-out, with communication regarding each phase, installation time and testing disseminated to residents in advance. A website should be set up by the utility or city to keep residents up to date on the progress of the meter installations. After installation, a web-based reporting system should be implemented to help residents track their daily electricity usage and learn about strategies for saving electricity and reducing their bill.

Demand response capability through local distributed networks has already been planned for the future to reduce periods of extreme load, curtail any overstretched demand on power generation capacity, and avoid unnecessary investments in new grid capacity if the city grows further.

Several ITU-T Recommendations from Y.4000 to Y.4999: 'Internet of things and smart cities and communities' contain guidance on IoT applications and ubiquitous sensor networking, including, for example, standards such as ITU-T Y.4409/Y.2070: 'Requirements and architecture of the home energy management system and home network services'.

For specific projects already planned and underway, please see the section on 'Goals and Projects for a Smart Sustainable Future'.

Buildings

Category	KPI	Result	Performance to Benchmark	SDG
	Public Building Sustainability	Not Reported		11 SUSTAINABLE CITIES AND COMMUNITIES
	Integrated Building Management Systems in Public Buildings	Not Reported		

Buildings play an enormous role in our lives, cities and environment. Due to this, it is recommended that Riyadh records and reports data on any sustainability certifications for its public buildings and on the public building area that is monitored via automated and integrated building management ICT systems. If it is found that building sustainability certifications are not yet prevalent, hundreds of standards, rating and certification programmes can be chosen from to help guide, demonstrate and document efforts to deliver sustainable and high-performance public buildings. In fact, standards for green building performance should be made mandatory for publicly funded projects, and should be combined with policy tools related to energy labelling, carbon emissions, sustainable procurement, and so on, to play a key role in energy use reduction.

Optimizing Building Services: To this end, it is recommended that Riyadh implements Recommendation ITU-T L.1370 'Sustainable and Intelligent Building Services' on the requirements for efficient, sustainable and intelligent building (SIB) management. It is also recommended that Riyadh keeps apprised of the upcoming Draft Recommendation ITU-T L.SP_OB: 'A methodology for improving, assessing and scoring the sustainability performance of office buildings', which will provide a framework to critically assess ten key areas of environmental performance and management, including:

- Energy
- Water
- Air
- Comfort
- Health and Wellness
- Purchasing
- Custodial
- Waste
- Site
- Stakeholders

Transport

Category	KPI	Result	Performance to Benchmark	SDG
	Dynamic Public Transport Information	Not Reported		
	Traffic Monitoring	37.99 %		
	Intersection Control	63.64 %		
	Public Transport Network (per 100 000 inhabitants)	55.87 km		
	Public Transport Network Convenience	Not Reported		
	Bicycle Network (per 100 000 inhabitants)	0.00 km		11 SUSTAINABLE CITIES AND COMMUNITIES
	Transportation Mode Share: Private Vehicles	98.00 %		
	Transportation Mode Share: Public Transport	2.00 %		
	Transportation Mode Share: Walking	0.00 %		
	Transportation Mode Share: Cycling	0.00 %		
	Transportation Mode Share: Para Transport	0.00 %		
	Travel Time Index	1.30		
	Shared Bicycles (per 100 000 inhabitants)	0.00		

Category	KPI	Result	Performance to Benchmark	SDG
	Shared Vehicles (per 100 000 inhabitants)	0.00		
	Low-Carbon Emission Passenger Vehicles	0.00 %		

With its grid system of wide roads and highways, modern Riyadh was designed as an automobile-oriented city. This is reflective in the fact that the significant majority of trips in the city are taken by car. The data also shows that there is room for improvement when it comes to the diffusion and utilization of ICTs in Riyadh's road and transportation infrastructure.

Optimizing transport: Traffic anti-congestion measures including adaptive traffic control or prioritazation measures are in the process of being employed by the city, as part of the Riyadh Development Authority (RDA) Traffic Management programmes that are explained briefly in the section on 'Goals and Projects for a Smart Sustainable Future'.

Riyadh has also invested heavilty in expanding its public transport network. The Riyadh Metro project will become operational in 2020. It will see 6 metro lines over 176 km incorporating 85 stations. The opening capacity is expected to be 1.16 million passeners per day, going to a maximum of 3.6 million passengers per day. The bus network will see 24 lines introduced, covering 1 230 km over 6 700 stops throughout the city. Over 950 state-of-the-art ICT-enabled and and enviromentally friendly buses will run through this network. 5 control and operation centres will manage the movement of all trains and buses, utilizing:

- supervisory control and data acquisition (SCADA) architecture;
- 1 600 telephone and intercom units;
- 600 access control and intrusion detection units;
- 9 200 public address units;
- 3 800 passenger information units,
- 10 000 CCTV surveillance cameras;
- early warning systems;
- fire extinguishing systems; and
- tunnel safety systems.

It is recommended that, in addition to the above, Riyadh also incentivize vehicle sharing services and carpool programmes as alternatives to high private vehicle usage.

Electric vehicles (EVs) will further help reduce the exhaust emissions that contribute to climate change and smog, thereby improving public health and reducing ecological damage, especially when renewable

energy is used to charge the cars. EVs are also much more efficient than internal combustion engine (ICE) cars, which means that less energy is needed for EVs to run than traditional cars.

Cities like Riyadh, where millions of people drive, present an excellent opportunity for realizing the greatest impacts of reduced carbon emissions. It is recommended that Riyadh incentivize (through rebate programmes, for example) the use of EVs as well and install standardized, interoperable charging points all over the city. Ordinances should be introduced that require a certain percentage, such as 25 per cent, of parking spaces in all buildings to be EV-ready.

There are several ITU-T Recommendations that could help with the above, such as Y.1300 to Y.1399: 'Transport' and Y.1700 to Y.1799: 'Operation, administration and maintenance'. In private vehicle heavy cities, standards such as ITU-T Y.4456: 'Requirements and functional architecture for smart parking lots in smart cities' can also help guide measures to alleviate vehicle congestion or to optimize flow.

Urban Planning

Category	KPI	Result	Performance to Benchmark	SDG
	Pedestrian Infrastructure	Not Reported		
	Urban Development and Spatial Planning: Compact	YES		
	Urban Development and Spatial Planning: Connected	NO		SDG 11 SUSTAINABLE CITIES AND COMMUNITIES
	Urban Development and Spatial Planning: Integrated	YES		
	Urban Development and Spatial Planning: Inclusive	YES		
	Urban Development and Spatial Planning: Resilient	YES		

To be considered 'sustainable', urban plans should have all of the five elements listed above, demonstrated through evidence-based and innovative methodology.

Optimizing urban planning: It is recommended that Riyadh engages in spatial assessment and planning to identify existing places and plans for more within the city that demonstrate high connectivity.

Creating more pedestrian zones will also help optimize Riyadh's urban planning results. It is recommended that the city researches and employs key considerations or guidelines[10] when planning and designing such zones.

KPI Dimension 2: Environment

The second U4SSC KPIs dimension is Environment. This dimension includes the sub-dimensions of Environment and Energy. The Environment sub-dimension covers a range of indicators classified according to categories, some of which can also be found in the first (Economy) dimension. The KPIs include those for air quality, water and sanitation, waste, environmental quality and public space and nature. They aim to assess the use of ICTs in supporting urban environmental services and improving the overall environmental quality in cities.

The Energy sub-dimension includes all KPIs that report on energy. These KPIs aim to assess the use of renewable and sustainable sources of energy, as well as the energy efficiency and energy reduction measures in a city. This dimension examines the level of ICT integration in supporting environmental sustainability and energy efficiency. These KPIs also provide a key baseline for future comparison, because achieving efficient use of resources via ICTs will be fundamental to Riyadh's, and every other aspiring smart sustainable city's long-term environmental sustainability.

The following diagram summarizes Riyadh's KPI performance detailing the categories within the Environment dimension against the current U4SSC benchmarks.

ENVIRONMENT
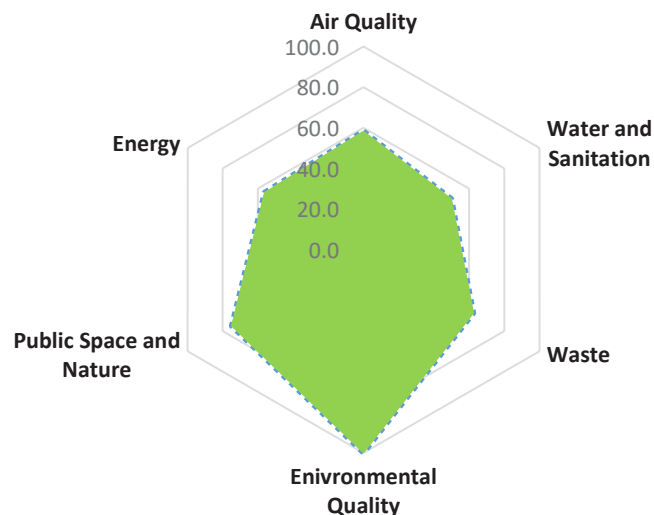
Air Quality

Category	KPI	Result	Performance to Benchmark	SDG
	Particulate Matter (PM$_{2.5}$)	64.00 µg/m³		
	Particulate Matter (PM$_{10}$)	218.00 µg/m³		
	Nitrogen Dioxide (NO$_2$)	105.35 µg/m³		**11 SUSTAINABLE CITIES AND COMMUNITIES**
	Sulphur Dioxide (SO$_2$)	9.68 µg/m³		
	Ozone (O$_3$)	58.00 µg/m³		
	GHG Emissions (eCO$_2$ / capita)	9.10 tonnes		

Compared to the World Health Organization (WHO) guidelines on the major components of air pollution, Riyadh's performance shows some room for improvement. This would be important in the fight against climate change and for the overall health of the city's environment and residents.

Notably, as Riyadh's reported value for greenhouse gas emissions (GHGs) is almost twice that of the Arab region's emissions of 4.7 tonnes, the city should 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 gas emission guidelines'. Doing so will provide the city a roadmap to address the Connect 2030 GHG emissions target, while considering SDG 13 and the objectives of the Paris Agreement.

Reduction of particulate matter is needed in Riyadh and can be achieved in several ways through a comprehensive control strategy that combines strong regulations with incentive approaches, such as the following:

- Smoke from factories, power plants, and large industrial and manufacturing facilities should be regulated.
- Strict emission standards for cars and other motor vehicles such as trucks, buses, motorcycles and trains should be mandated, along with the development of fuel specifications for all vehicles and periodic inspection and maintenance.

- Food and yard waste accounts for a large portion of household waste stream and when thrown into regular trash it ends up in landfills, where it contributes to air pollution. Residents and businesses should be encouraged to discard such waste appropriately and to mulch it instead of burning it.

- The use of wood stoves should be limited and compliance of any such stoves with current emissions standards should be made a requirement.

- Diesel emissions should be reduced by mandating that older engines be replaced with newer and greener ones.

- Residents should be encouraged to take public transport, especially during pollution alerts.

- Efforts should be made to shift consumer behaviour toward sustainable preferences and practices through public education and information initiatives by the government.

- Emission standards for small gasoline powered equipment, e.g. lawn mowers, gardening equipment, generators and chainsaws, should be adopted.

- Any businesses that are sources of volatile organic compounds should be regulated.

- Lastly, all sources of particulate matter in the city should be studied as part of a comprehensive approach, and cross-border action with other cities and regions should be coordinated.

Optimizing air quality: An integrated approach to climate change and air pollution should be considered to reduce the risks of applying climate change measures with significant negative impacts on air quality. Continual cooperation with other levels of government is also important, as air pollution is not just a local problem. As transboundary sources are often major contributors to urban pollution, many cities or regions are unable to continue meeting WHO guideline levels for air pollutants through local action alone.

Recommendations such as ITU-T Y.4207: 'Requirements and capability framework of smart environmental monitoring' and Y.4700/F.747.2: 'Deployment guidelines for ubiquitous sensor network applications and services for mitigating climate change' can be of significant help in smart sustainable cities' efforts to monitor and mitigate air pollution.

Public Space and Nature, and Environmental Quality

Category	KPI	Result	Performance to Benchmark	SDG
	Green Areas (per 100 000 inhabitants)	237.60 ha		
	Green Area Accessibility	21.00 %		SDG 11 SUSTAINABLE CITIES AND COMMUNITIES
	Protected Natural Areas	11.90 %		
	Recreational Facilities (per 100 000 inhabitants)	590 000 m^2		
	EMF Exposure	100.00 %		SDG 16 PEACE, JUSTICE AND STRONG INSTITUTIONS
	Noise Exposure	Not Reported		SDG 11 SUSTAINABLE CITIES AND COMMUNITIES

Although Riyadh generally performs well in these categories, there is room for improvement as regards access to green areas. It is important that a city's green areas not only be expansive and contiguous, but also easily accessible to most citizens. It has been found that the 'quality and function of green space as well as their geographic determinants in terms of access are of higher importance than green space surface per capita; the latter often used by decision makers and public health promoters in planning. It is also well documented that people who are living closer in proximity to green space are more likely to use it; as green space provides mental health benefits, social interaction, and has a "direct relationship with the quality of life of urban dwellers".'[11] This is reflected in various studies across different disciplines that have shown that 'the environmental, ecological and social benefits of urban green space (UGS) vary according to size, distance and accessibility'.[12]

Optimizing green areas: It is recommended, therefore, that Riyadh examine how best to integrate walkability, accessibility and path networks for green areas into the planning of the city's subdivisions

and consideration of its enhancement and sustainable development plans. As part of the Saudi Vision 2030, the city has already developed a Green Riyadh Strategy with the following objectives:

1. increase vegetation coverage;

2. promote public health;

3. decrease temperatures;

4. protect against storm water and floods;

5. improve the urban environment and quality of life;

6. incentivize the community to enhance green area coverage;

7. enhance sport/leisure activities. ensuring accessibility; and

8. increase economic value and attract investment.

Through this strategy, the city hopes to provide a clear direction that its previous dispersed greening initiatives had lacked. A comprehensive current state analysis has already been carried out as part of the strategy, along with benchmark analysis comparing Riyadh's current green state to that of leading global cities. Best practices for implementation have been identified based on the experiences and results seen by international cities, and areas of focus, opportunity and strategic enablers have been similarly been identified. A budget amount has been allocated for each phase of the project, along with the determination of an overall project implementation approach.

Lastly, many ITU-T Recommendations in the K series: 'Protection against interference' can provide further insight into limiting and managing the effects of EMFs in the future.

Water and Sanitation

Category	KPI	Result	Performance to Benchmark	SDG
	Drinking Water Quality	100.00 %		
	Water Consumption (per capita)	350.57 ℓ / day		
	Freshwater Consumption	33.00 %		6 CLEAN WATER AND SANITATION
	Wastewater Treatment: Primary	79.22 %		
	Wastewater Treatment: Secondary	24.50 %		
	Wastewater Treatment: Tertiary	0.02%		

Water safety and quality are priorities in Saudi Arabian cities, including Riyadh, which is reflected in the city's overall positive performance in this category. However, Riyadh's consumption figures are significantly higher than the average national levels of approximately 265 litres per capita.[13] This is notable as Saudi Arabia is the world's third largest per capita consumer of water (after the US and Canada).[14]

Optimizing water consumption and sanitation measures: The country recognizes the above and, at the Saudi Water Forum 2019 on 22 March 2019 (that was held in conjunction with World Water Day), announced a national programme called 'Qatrah' (which means 'droplet' in Arabic) for water conservation in the kingdom. The programme aims to reduce daily per capita water consumption across the country by nearly 24 per cent in 2020 to 200 litres, and by 43 per cent to 150 litres by the end of the next decade, i.e. 2030.[15] This effort is important as most of the country's water comes from non-renewable groundwater found in deep fossil aquifers, or from desalination.

In order to achieve the targets set by the Qatrah programme, it is recommended that Riyadh analyse its high water consumption and monitor how much customer water demands (residential and business/industrial) account for of the city's total water production volume. This should be summplemented by evaluation of peak day, time and seasonal water consumption trends. The city should then set progressive annual, quarterly, monthly or daily water consumption targets that consider reasonable customer demand and an acceptable level of non-revenue water.

In the past, Riyadh has taken successful steps in this regard, including increasing water tariffs and distributing free efficient water appliances (e.g. taps, shower heads) that resulted in notable residential

water use decreases.[16] These efforts should be continued by encouraging (through education and awareness) the recycling of fresh water within homes via greywater re-use systems.

Increasing wastewater treatment rates across the three treatment levels is also recommended for Riyadh. While water re-use in general is increasing in Saudi Arabia, more re-usable water can be made available through treatment for large-scale non-drinking commercial purposes.

ITU Supplements such as L Suppl. 14: ITU-T L.1500: 'Standardization gap analysis for smart water management' and L Suppl. 15: ITU-T L.1500 series: 'Requirements for water sensing and early warning systems' should be utilized by cities when actualizing their smart water management policies.

Waste

Category	KPI	Result	Performance to Benchmark	SDG
	Solid Waste: Landfill	77.67 %		
	Solid Waste: Burnt	0.00 %		
	Solid Waste: Incinerated	0.00 %		11 SUSTAINABLE CITIES AND COMMUNITIES
	Solid Waste: Open Dump	13.00 %		
	Solid Waste: Recycled	9.33 %		
	Solid Waste: Other	0.00 %		

All cities are recommended to prioritize solid waste recycling in a regulated facility over all other forms of disposal.

Optimizing waste recycling: While Riyadh is not unique in reporting low rates of recycling, in that many cities generate more solid waste than can be readily disposed (which can lead to adverse effects on the environment and public health), it is recommended that the city devlops its recycling capability and culture as a key priority by following steps such as:

- investing further in recycling infrastructure and mechanisms;
- enhancing public communication and outreach to increase public participation in recycling;
- evaluating the recyling markets and pricing levels for materials;
- evaluating existing haulier contracts and expanding or modifying them accordingly;
- modifying existing collection techniques to enhance any existing programme efficiencies and diversity; and
- legislating and funding smart recycling that utilizes ICTs in waste management.

As increasing generation of e-waste is a burgeoning issue, ITU Recommendations such as ITU-T L.1032: 'Guidelines and certification schemes for e-waste recyclers' and Supplements such as ITU-T L Suppl. 4: 'Guidelines for developing a sustainable e-waste management system' can be vital in cities' efforts to monitor and manage the issue.

Energy

Category	KPI	Result	Performance to Benchmark	SDG
	Renewable Energy Consumption	0.00 %		
	Electricity Consumption (per capita)	9 032.14 kWh / yr		7 AFFORDABLE AND CLEAN ENERGY
	Residential Thermal Energy Consumption (per capita)	0.74 Gj / yr		
	Public Building Energy Consumption (per year)	70.87 ekWh / m^2		

Lastly, while Riyadh's annual residential thermal energy consumption is low, its overall per capita electricity consumption is very high. This is in line, however, with the average national figure of 9 444.22 kWh (2014).[17] So, reducing this high consumption and a shift to utilizing more renewable energy should be key priorities for the country and for the City of Riyadh.

Optimizing energy consumption: The kingdom has recently taken steps in this regard, including increasing gasoline and electricity prices and putting in place plans to issue tenders for at least 12 renewable energy projects in 2019 in order to diversify the country's energy mix. Over the next 10 years, the kingdom plans to develop around 60 gigawatts (GW) of renewable energy capacity, including 40 GW of photovoltaic solar power, 3 GW of concentrated solar power and 16 GW of wind power.[18] At the local level, cities such as Riyadh can also contribute to this goal by employing environmentally friendly incineration practices to convert the municipal waste (produced by the residential, commercial and public service sectors) to sources of production of heat and power.

For specific projects already planned and underway in this regard, please see the section on 'Goals and Projects for a Smart Sustainable Future'.

Standards that guide modernization and optimization of various public energy use sources should be utilized, including, for example, Recommendations such as ITU-T Y.4458: 'Requirements and functional architecture of a smart street light service', ITU-T L.1210: 'Sustainable power feeding solutions for 5G networks', ITU-T L.1316: 'Energy efficiency framework' and Supplements such as L Suppl. 36: ITU-T L.1310: 'Study on methods and metrics to evaluate energy efficiency for future 5G systems'.

KPI Dimension 3: Society and Culture

The third U4SSC KPIs dimension is Society and Culture. This dimension covers the sub-dimensions of Education, Health and Culture, as well as Safety, Housing and Social Inclusion. As with the first two dimensions, each sub-dimension covers a range of indicators classified according to its categories.

KPIs in Education, Health and Culture aim to assess the impact of the ICTs that improve citizens' quality of life. They focus on areas such as education, health and societal culture, among others.

Safety, Housing and Social Inclusion contains a KPI related to food security, in addition to those related to safety, housing and settlements, along with social encompassment.

These KPIs aim to assess the impact of the use of ICTs to promote urban equity, citizen participation and to enhance social inclusiveness. They focus on the themes of openness, public participation and transparency in governance. The 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 here.

There is emphasis on 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 efficient governance and maintain the inclusiveness of the city inhabitants as stakeholders pivotal to the city's decision-making processes. They ensure that the health, education and safety services are deployed with the least amount of disruption, wait times and manual intervention possible.

The following diagram summarizes Riyadh's KPI performance detailing the categories within the Society and Culture dimension against the current U4SSC benchmarks.

SOCIETY & CULTURE
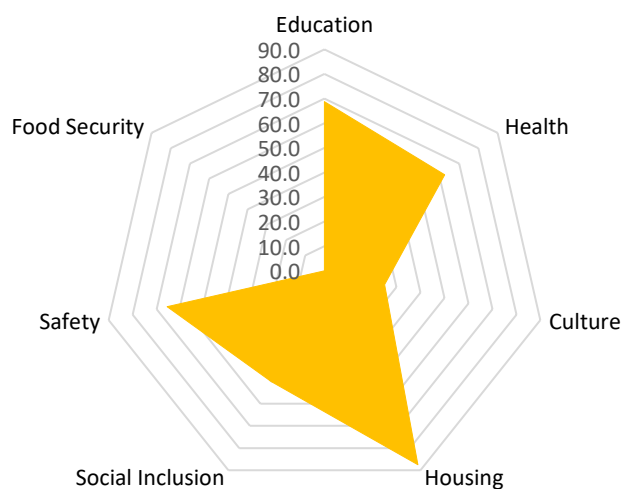
Education

Category	KPI	Result	Performance to Benchmark	SDG
	Student ICT Access	32.39 %		
	School Enrolment	97.51 %		
	Higher Education Degrees (per 100 000 inhabitants)	17 233		4 QUALITY EDUCATION
	Adult Literacy	96.00 %		

Riyadh performs well across all most of these indicators. For example, it benefits from the presence of several universities, including the King Saʿūd University, the Islamic University of Imam Muḥammad ibn Saʿūd, as well as a number of military academies such as the King ʿAbd al-ʿAzīz Military College, the King Khālid Military College and the King Fahd Security College.

The one area that should be a focus for development, however, is the provision of ICTs to students in schools. A planned, integrative approach for all levels of education from the relevant level of government's education and technology departments is recommended.

Making learning smart: This should include adoption of e-learning systems for students and fostering public-private partnerships that will invest in the city's schools to develop a future labour force that is ICT ready. The socio-economic disparities among various neighborhoods should be accounted for and mitigated in this proposed approach. Policies should ensure inclusiveness by offering media, internet, and digital literacy to all students, regardless of city area or socio-economic group. Investment should also be made toward teacher support and other policies aimed at effective ICT use by school administrators. Detailed ICT education itself should be integrated into the standard school curriculum. Lastly, ICT introduction policies should employ incremental, agile and forward-looking pathways by bringing in sustainable and easily upgradable ICTs into the schools.

For specific projects already planned and underway in this regard, please see the section on 'Goals and Projects for a Smart Sustainable Future'.

Health

Category	KPI	Result	Performance to Benchmark	SDG
     	Electronic Health Records	0.00 %		
	Life Expectancy	74.00 yrs		
	Maternal Mortality Rate (per 100 000 live births)	9.78		3 GOOD HEALTH AND WELL-BEING
	Physicians (per 100 000 inhabitants)	187.36		
	In-Patient Hospital Beds (per 100 000 inhabitants)	185.21		
	Health insurance / Public Health Coverage	100.00 %		

This set of KPIs signifies mixed results for Riyadh. Life expectancy in the city is higher than the global average of 72 years (2016)[19] and in line with the national average of 74.56 (2016).[20] Saudi Arabia has a national healthcare system in which the government provides healthcare services through various government agencies and with participation from the private sector. All residents are eligible for health insurance or benefits that include most preventive, diagnostic, and curative services and pharmaceuticals (with few exclusions) and no cost sharing.

While Riyadh has reported a lower value for maternal mortality rate than the national average of 12 deaths per 100 000 live births (2015),[21] its rate still requires further examination. Maternal mortality as a health indicator tends to show wide gaps between the rich and the poor, and in between urban and rural areas. In general, most maternal deaths occur in low-resource settings, and are often found to be preventable.

Optimizing smart, effective healthcare: It is recommended, therefore, that Riyadh further examines its maternal mortality rate to define the distribution, frequency and determining factors involved. The factors should include (but not be limited to): diagnosed cause(s); ease of access, to and affordability of, medical care; geographic zone; maternal age; ethnic or other socio-economic background. Administrative data should be combined with qualitative surveys to gather the information necessary to inform policies that will help lower this rate in the future.

Instituting electronic health records (EHR) for Riyadh's residents is another recommendation. Saudi Arabia is taking steps in this regard as part of its Vision 2030 strategy, which will likely see the

implementation of a unified, cloud-based EHR system in all hospitals across the kingdom. It will be important, however, that smaller, local clinics are also incentivized to move from paper or rudimentary digital operations to more sophisticated electronic systems. Concerns relating to technical issues, lack of training and data security are expected to be key areas of focus during the investment into cloud computing and mobility within the kingdom's healthcare sector.[22]

For specific projects already planned and underway in this regard, please see the section on 'Goals and Projects for a Smart Sustainable Future'.

ITU Recommendations such as ITU-T Y.4408/Y.2075: 'Capability framework for e-health monitoring services' and ITU-T Y.4110/Y.2065: 'Service and capability requirements for e-health monitoring services' can help cities optimize their e-health service provision.

Culture

Category	KPI	Result	Performance to Benchmark	SDG
	Cultural Expenditure	0.21 %		11 SUSTAINABLE CITIES AND COMMUNITIES
	Cultural Infrastructure (per 100 000 inhabitants)	Not Reported	No Benchmark Available	

Riyadh contains many prominent cultural institutions, including the King ʿAbd al-ʿAzīz Historical Centre, which is a collection of restored historic buildings that contain a mosque, a library and a conference hall that showcase the history of the Kingdom's foundation and development. Riyadh also houses the country's famous National Museum and National Library. Several squares, markets, public parks and restaurants adorn the city. The city is also home to several major events, such as Al-Jinādiriyyah, a national heritage and culture festival that hosts Arab, Muslim, and international celebrities participating in panel discussions, intellectual forums and poetry sessions. It offers exhibitions, shopping, cultural shows and other entertainment.

The Al-Jinādiriyyah festival alone attracts many visitors and participants to Riyadh. As increasing tourism in this way is a key Saudi Vision 2030 goal, it will need a higher level of investment in the preservation, protection and exhibition of each city's culture and historical heritage. While Riyadh currently spends less than a quarter of 1 per cent of its GDP on its cultural and natural heritage, Saudi Arabia's new National Transformation Plan will see nearly $1 billion distributed to preserve the cultural heritage.[23] It is recommended that Riyadh also inventories its cultural infrastructure sites as part of this effort and reports that KPI in future years.

Housing and Social Inclusion

Category	KPI	Result	Performance to Benchmark	SDG
	Informal Settlements	0.23 %		
	Housing Expenditure	22.40 %		
	Gender Income Equity (ratio of Female : Male)	0.88		
	Gini Coefficient	0.55		
	Poverty Rate	0.50 %		
	Voter Participation	0.50 %		
	Child Care Availability	Not Reported		

Riyadh reports an average annual household income of USD 23 772, in line with the median self-reported gross national income of USD 24 980.[24] Of this, less than a quarter is spent on housing expenditure. Compared to the prescribed maximum range of 25 per cent to 30 per cent, and the OECD average of 20 per cent,[25] this rate of housing expenditure is positive, but must continue to be monitored to ensure that it remains sustainable.

Gender income equity in Riyadh in the form of the ratio of average hourly earnings of female workers to male workers is reported to be 0.88. While this ratio is higher than many other cities around the world, work needs to be done to address the vast overall employment gender gap between women and men. Women in the entire MENA region continue to face cultural, legal and social barriers to working, with the level of joblessness among young women much higher than that for men even in countries like Saudi Arabia.[26] These trends translate into lower lifetime earnings for working women.
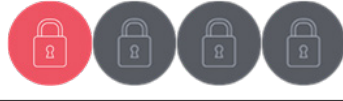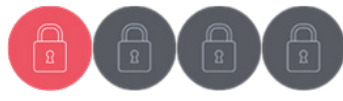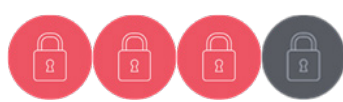
Ensuring gender parity and representation: To this end, it is recommended that all cities in Saudi Arabia, including Riyadh, draft comprehensive Local Equality Action Plans as roadmaps for increasing gender parity outcomes in the areas of employment, participation in management mechanisms, education, health, prevention and redress of violence against women and urban services. The UN Convention on the Elimination of All Forms of Discrimination against Women and other international conventions are helpful sources that can provide guidance in this regard.[27] The city should also conduct gender parity analysis of its municipal departments, commissions and boards.

As motherhood and lack of support in household duties are two universally cited reasons around the world for women either working fewer hours or leaving the labour force entirely, collecting data on and reporting day-care availability for children is also recommended for Riyadh.

Lastly, while Riyadh has reported 0.50 per cent voter participation, the chief administrator of the city – its Mayor – is appointed by the King of Saudi Arabia. The city's socio-economic, cultural and environmental development policies are formulated by its executive branch, the Arriyadh Development Authority (ADA) and are overseen by the High Commission for the Development of Riyadh.[28] Even so, the city has committed to increasing rates of public participation.

For specific projects already planned and underway in this regard, please see the section on 'Goals and Projects for a Smart Sustainable Future'.

Safety and Food Security

Category	KPI	Result	Performance to Benchmark	SDG
	Natural Disaster-Related Deaths (per 100 000 inhabitants)	0.31		13 CLIMATE ACTION
	Disaster-Related Economic Losses (relative to City GDP)	0.00 %		
	Resilience Plans	No		11 SUSTAINABLE CITIES AND COMMUNITIES
	Population Living in Disaster-Prone Areas	5.73 %		
	Emergency Service Response Time	13.43 mins		
	Fire Service (per 100 000 inhabitants)	11.13 FTE		3 GOOD HEALTH AND WELL-BEING
	Traffic Fatalities (per 100 000 inhabitants)	10.83		
	Police Service (per 100 000 inhabitants)	175.76 FTE		16 PEACE, JUSTICE AND STRONG INSTITUTIONS
	Violent Crime Rate (per 100 000 inhabitants)	157.68		
	Local Food Production	Not Reported		2 ZERO HUNGER

While Riyadh reported few natural disaster-related deaths and had no natural disaster-related economic losses, it considers almost 6 per cent of its inhabitants as living in a zone subject to natural hazards. It is recommended that the city invests accordingly in the development and implementation of risk and vulnerability assessments for potential disaster mitigation that are in line with the Sendai Framework

for Disaster Risk Reduction 2015–2030. The Sendai Framework requires the following elements to be implemented:

a) city infrastructures and systems available for resilience;

b) risk and vulnerability assessments;

c) financial (capital and operation) plans to mitigate address the risks and vulnerabilities; and

d) technical systems to implement the plans.

Lowering its average emergency response times and increasing law enforcement and fire personnel coverage are also recommendations for Riyadh. This should include:

• an assessment of overall emergency response needs and capabilities, including determination of the strengths and weaknesses of current emergency response planning;

• a model asset inventory to identify the human and material, e.g. ICT-based, resources that are available or missing;

• optimization of emergency response procedures and development of a model emergency response exercise guide; and

• development or enhancement of training programs and materials based on the gaps identified.

Lastly, ITU Recommendations such as ITU-T Y.4116: 'Requirements of transportation safety services including use cases and service scenarios' and ITU-T Y.4119: 'Requirements and capability framework for IoT-based automotive emergency response system' can help make smart sustainable cities safer and more prepared.

Goals and Projects for a Smart and Sustainable Future

As the analysis of Riyadh's U4SSC KPIs in this report shows, Riyadh is well positioned to develop structured and measurable smart sustainability strategies for the coming decades. It performs well on several U4SSC indicators that it has reported. In conceptualizing its vision for the foreseeable future, therefore, Riyadh can employ a two-fold focus:

1. maintain performance levels in the KPIs that meet the corresponding SDG Targets and that benchmark well in comparison to regional, national, or global city data; and

2. build a framework of policies that will enact improvements in the KPIs that potentially require intervention.

Riyadh's smart sustainable city (SSC) goals are expected to align with the national overall Saudi Vision 2030 strategy and its goals. The ADA's Riyadh Smart City Implementation Roadmap outlines the city's goals and provides a 3–5 year high-level implementation plan that it expects to employ. The Roadmap contains important milestones with dependencies and timelines for several key focus areas, including:

- **Resources**: The effective utilization of resources, including: ICT infrastructure (city systems, city IoT and city networks), city data, smart applications, smart city platform, and smart services portfolio.

- **Governance Structure**: With multiple stakeholders and competing agendas, an agile governance model is needed to see Riyadh through this transformation.

- **Regulatory Framework**: An appropriate regulatory framework (including policies, laws, and regulations) is critical to ensuring cooperation between stakeholders and adherence to smart city standards.

- **Public-Private Partnerships**: The private sector is a key contributor throughout the implementation phase and beyond.

- **Public Participation:** Public participation will assure alignment in the smart service supply and demand model within the Riyadh smart city. It will, henceforth, continue to be enhanced through a specific framework and tools.

- **Stakeholder City Experience**: An improved stakeholder city experience is the ultimate end goal of the Riyadh Smart City Masterplan.

Riyadh's U4SSC project, including this report, fulfils two particular steps of the Roadmap's implementation plan: 'Current State Assessment', and 'Research & Benchmarking'. Information provided by the city shows that it is already making positive headway in major areas that some key recommendations in the preceding sections are related to. These are summarized below according to the categories within the U4SSC sub-dimensions:

ICT Infrastructure

a. **Citywide WiFi** service that will provide the residents of Riyadh with free (restricted) and paid (high speed) WiFi access in all public areas, and free access to public and private city services.

b. **Municipal Open Access Fiber** optic networks that will be leased to telecom operators, businesses, local authorities and organizations. This will encourage IT development and strong growth in the city.

c. **IoT Devices Onboarding** that will see various IoT devices deployed and managed by government entities using a multitenant IoT management platform, which will intake and analyse data on an ongoing-basis.

Innovation

a. **The Broadband Lab** is an experimentation platform that gathers resources and technical means to help businesses prototype and develop their innovative digital services and contents on optical-fibre, high-speed broadband networks.

Public Sector

a. **Citywide Digital Signage** that will provide interactive displays using smart screens that integrate information from open government programmes, local businesses and citizens to provide useful information received from connected sensors, monitors and intelligent data tools in real time to the public.

Electricity Supply, and Water and Sanitation

a. **Smart Grid** that will allow utilities to maintain grid reliability and improve operations through the application of digital processing and communications via smart technology. The Smart Grids will also enable Automated Demand Response capabilities, add alternative energy sources (such as wind and solar), meet growing energy demand efficiently and allow customers greater control over their consumption.

b. **Smart Metering** that will remotely report the consumption of electricity, water and gas in near real-time, identifying household consumption patterns and prescribing adjustments to reduce usage and costs. Analysis of the data gathered will facilitate: decisions impacting energy efficiencies; the launch and support of incentive, rebate or tariff programmes; the detection of energy theft; the reduction of unbilled energy and non-revenue water; and accurate demand and usage forecasting.

Transport

a. **Intelligent Transport System (ITS)** that will monitor and manage the city's traffic through inputs from various sensors and the smart CCTV surveillance system (see below). It will utilize advanced analytics to conduct historical, real-time and predictive traffic analysis, including contextualized incident and traffic reporting, to inform traffic dashboards and KPIs for reporting. It will display real-time traffic maps on a 3D city map that will be used by a variety of stakeholders for planning, scenario testing and emergency response. The ITS will ease traffic congestion, improve traffic flow, and reduce air pollution in the city.

b. **Smart Parking** that will see public and private parking spaces (including municipal parking, garages, private parking lots, hotels and hospitals) across the city equipped with wireless sensors. A mobile application will provide availability information, route guidance to the most optimal parking space, cost, scheduling, payment and the option to use shared parking. Sensors and automated gates/bollards will be used to control access and calculate usage. The resulting data will be analysed to calculate supply-and-demand pricing models and for planning purposes.

c. **Driverless Transport** equipped with sensors that allow them to react to their environment and accurately be routed and monitored remotely is being tested to enhance mobility in the city centre. Tested scenarios include excluding cars from certain areas, utilizing fixed route autonomous vehicles and dedicating lanes on busy transit routes.

Urban Planning

a. **Smart Street Lighting** that will see the conversion of Riyadh's streetlights to LED or other energy-saving technologies while optimally using ambient light and motion detection on roads to control streetlight intensity and functions. Remote monitoring and control will allow for efficient maintenance schedules and lower costs while improving efficiency.

Safety

a. **Smart CCTV Surveillance** systems that will record and store real-time video footage of public areas using motion detectors, low-light enhancers, and heat and smoke detectors. The systems will understand activities, detect unusual events and alert the authorities if needed.

b. **Drone Surveillance** that will be activated as needed by authorities and CCTV alerts to cover areas that normal CCTV surveillance, security personnel or ground vehicles cannot reach.

c. **Disaster Management** and Emergency Response Centre that provides situational response regarding safety and security to city stakeholders. By compiling and representing real-time graphical data, the Centre coordinates emergency and disaster measures. It also acts as an integrated disaster prevention facility and base for disaster medical care support. Data are also coordinated with the private sector and inputs from social media, adjoining regions or citywide systems for early warning and prevention.

Conclusion

This has been the first year of Riyadh's collaboration with ITU on this project that is designed, in part, to continue the evaluation of the feasibility of the U4SSC KPIs for SSC. The following conclusions have been derived based on Riyadh's experience in its U4SSC smart sustainable journey:

• 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 indicators that can be reported easily by most cities, along with a list of advanced indicators. The advanced indicators can be reported by cities that have attained good scores on the basic indicators. Riyadh successfully reported 98 per cent of all core U4SSC indicators and 59 per cent of all advanced indicators as well.

• It is expected that the key findings from Riyadh's experience will also help towards improving the existing definitions of the U4SSC KPIs, in order to enable a smoother data collection process again for Riyadh and, potentially, other Saudi Arabian cities in the future.

• Riyadh should build on its first year of reporting the U4SSC KPIs by instituting the mechanisms and further developing capabilities to quantify, measure, collect and report data relevant to any remaining KPIs (that were not reported in its first year). The city should also adopt the various recommendations contained in this report to its specific context, and report data in subsequent years after the implementation of new measures. Doing so will also allow for year-over-year progress benchmarking and analytics.

• Riyadh should collaborate on its SSC efforts with other cities in the region in order to leverage any best practices and shared experiences with developing and instituting smart sustainable policies and initiatives in the region. Regular knowledge-sharing and discussions with ITU members and other international cities are also encouraged.

• Riyadh and its fellow aspiring smart sustainable cities should implement the recommendations and best practices mentioned in this Factsheet to improve the applicability of the KPIs across their cities/ regions and accelerate the achievement of their SSC goals in line with international instruments (such as the Paris Agreement, Connect 2030 Agenda, the UN Sustainable Development Goals and the New Urban Agenda).

• The vital knowledge gained through Riyadh's experience in implementing the U4SSC KPIs will continue to be a part of ongoing efforts to make not only the U4SSC KPIs, but also U4SSC's upcoming Smart Sustainable Cities Index the most effective methods to measure progress and provide guidance to cities around the world on their journey to becoming smarter and sustainable.

• Riyadh's reported KPIs will also feed into ITU's new maturity model. The ITU-T Recommendation Y.4904: 'Smart Sustainable Cities Maturity Model (SSC-MM)' is an additional tool to not only set and measure performance levels of each KPI by Riyadh and other cities, but to also measure the progress of other key dimensions for the development of a SSC including strategy, ICT infrastructure, data, services and applications and assessments, as further detailed in the box below.

Box 1: Smart Sustainable Cities Maturity Model

The Smart Sustainable Cities Maturity Model (SSC-MM) defines five levels of maturity in the process of becoming a smart and sustainable city, with each level achieved being a higher level of maturity. The requirement to reach the intended maturity level is to achieve the target KPI values set for each maturity level.

As an example, for KPI Household Internet Access, a level 1 maturity level could be to collect the initial benchmark data. The further four levels could then be set as performance levels such as level 2 achieved at 30% access, level 3 at 50% access, level 4 at 70% access and level 5 at 90% access.

This can then be overlaid with maturity-level performance for the other dimensions to provide insight into the issues that need to be addressed within each city to become smarter and more sustainable.

Riyadh and other cities are encouraged to use Recommendation ITU-T Y.4904 as a framework to determine their interim target values for KPIs by taking into consideration their priorities, constraints, resources and optimal KPI performance levels. The SSC-MM is another tool that can be used to communicate progress to stakeholders, help to develop and then execute a SSC strategy and encourage the effective use of ICTs.

More information on the SDGs, the U4SSC initiative and the U4SSC Smart Sustainable Cities Index can be found in the Appendix.

The ITU would like to invite cities around the world to implement the U4SSC KPIs for SSC. Using the U4SSC KPI definitions and data-collection methodologies, all cities will be able to better establish clear data-collection methodologies, collect data consistently in a structured way, develop goals and targets for each KPI and collect data regularly to track their progress toward smart sustainable goals.

Appendix
United for Smart Sustainable Cities (U4SSC)

United for Smart Sustainable Cities (U4SSC) is a UN initiative coordinated by ITU, UNECE and UN-Habitat, and supported by CBD, ECLAC, FAO, ITU, UNDP, UNECA, UNOPS, UNESCO, UN Environment, UNEP-FI, UNFCCC, UNIDO, UNU-EGOV, UN-Women and WMO to achieve Sustainable Development Goal 11: 'Make cities and human settlements inclusive, safe, resilient and sustainable'.

U4SSC advocates public policy to encourage the use of digital technologies toward facilitating and easing the transition to smart sustainable cities (SSC) by catapulting key successful smart city measures into the spotlight for consideration.

It currently works on 11 thematic groups:

• Guidelines on tools and mechanisms to finance SSC projects
• Economic and financial recovery in cities and urban resilience building in the time of COVID-19
• Guiding principles for AI in cities
• Blockchain 4 cities
• Impact of frontier technologies in cities
• Simple ways to be smart
• Practitioner guide to measure smart cities and communities (SC&C)
• Practitioner guide to monitor SC&C
• Procurement guidelines for SSC
• City platforms
• United for Smart Sustainable Cities Index

To find out more on the U4SSC initiative, visit: itu.int/go/u4ssc.

U4SSC Implementation Programme (U4SSC-IP)

The U4SSC Implementation Programme (U4SSC-IP) supports the implementation of projects and builds partnerships, which aim to build smarter and more sustainable cities worldwide.

To find out more on the U4SSC Implementation Programme, visit: https://www.itu.int/en/ITU-T/ssc/united/Pages/U4SSC-IP.aspx.

U4SSC Smart Sustainable City Index

The U4SSC indicators for SSC will form the basis for the U4SSC Smart Sustainable City Index. The Index will utilize the reported indicator values, along with supporting data profiling each city, to provide a comparative ranking amongst a selection of cities.

U4SSC in the International Context

The United Nations Sustainable Development Goals (SDGs)

'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 and UNECE, 2015)

The Sustainable Development Goals (SDGs) are a collection of 17 global goals set by the United Nations in 2015 as an urgent call for action by all countries – developed and developing – in a global partnership. They recognize that ending poverty and other deprivations must go together with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests.

The goals are broad and somewhat interdependent, yet each has a separate list of targets to achieve. The SDGs cover social and economic development issues including: poverty, hunger, health, education, climate change, gender equality, water, sanitation, energy, economic growth, innovation, sustainability, responsible consumption, environment, social justice and partnerships. There are 169 targets for the 17 goals; achievement of all targets signals the accomplishment of all 17 goals. Twenty of the targets are quantitative in nature, while the majority are more qualitative.

The SDGs were presented as part of the 'Transforming our World: 2030 Agenda for Sustainable Development'. The 2030 Agenda was developed to succeed the Millennium Development Goals (MDGs), which ended in 2015. Unlike the MDGs, the SDGs framework does not distinguish between 'developed' and 'developing' nations; instead, the goals are meant to apply to all countries.

Localization, i.e. implementation of the SDGs started worldwide in 2016. To further the progress of this localization, the SDGs are being promoted globally through several initiatives and advocacy platforms that are coordinated and supported by various UN programmes and agencies, including U4SSC in cities.

Meeting the SDGs is important for any city – particularly aspiring smart sustainable cities – because the SDGs framework is designed to help cities recognize priorities and establish long-term goals. The SDGs are designed to reveal the interdependent dynamics within various facets of sustainable development such as economic, social, and environmental conditions. The goals are meant to show, for example, how continued reliance on fossil fuels affects not only climate change and air quality but also public health, which then impacts poverty rates and economic opportunities. By working within the SDGs framework, policymakers can get to the root of their cities' issues.[29]

Also, the analytical framework of the SDGs lends itself to the use of clear baselines to improve internal planning and implementation. Other benefits include gap analysis, infusing priorities into a budget process, cutting programming redundancies and saving resources, and tracking outcomes. Cities can also engage across the global network of other governments and institutions that are pursuing the

same goals. The SDGs framework is also effective at different scales, offering the opportunity to align and harmonize policies and common goals vertically (up and down government jurisdictions), as well as horizontally (across city agencies). Therefore, if integrated and managed well, the SDGs can help strengthen local communities through values such as transparency, inclusion, and engagement.[30]

New Urban Agenda[31]

The New Urban Agenda represents a shared vision for a better and more sustainable future. It was adopted at the UN Conference on Housing and Sustainable Urban Development (Habitat III) in Quito, Ecuador, on 20 October 2016. Habitat III had the convening power to bring together all actors to identify solutions for the complex challenge of urbanization, including Member States, multilateral organizations, local governments, private sector and civil society. It helped to systematize the alignment between cities and towns and national planning objectives in their role as drivers of national economic and social development.

Urbanization is an unprecedented challenge, indeed. By the middle of 21st the century, four of every five people might be living in towns and cities. Urbanization and development are inextricably linked, and it will always be necessary to find a way to ensure the sustainability of growth.

The New Urban Agenda is premised on the basis that if well-planned and well-managed, urbanization can be a powerful tool for sustainable development and poverty reduction for developing and developed countries. Governments can respond to this key development opportunity by promoting a new model of urban development that is able to integrate all facets of sustainable development to promote equity, welfare and shared prosperity. The model would focus on all levels of human settlements, including small rural communities, villages, market towns, intermediate cities and metropolises for social and economic growth.

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