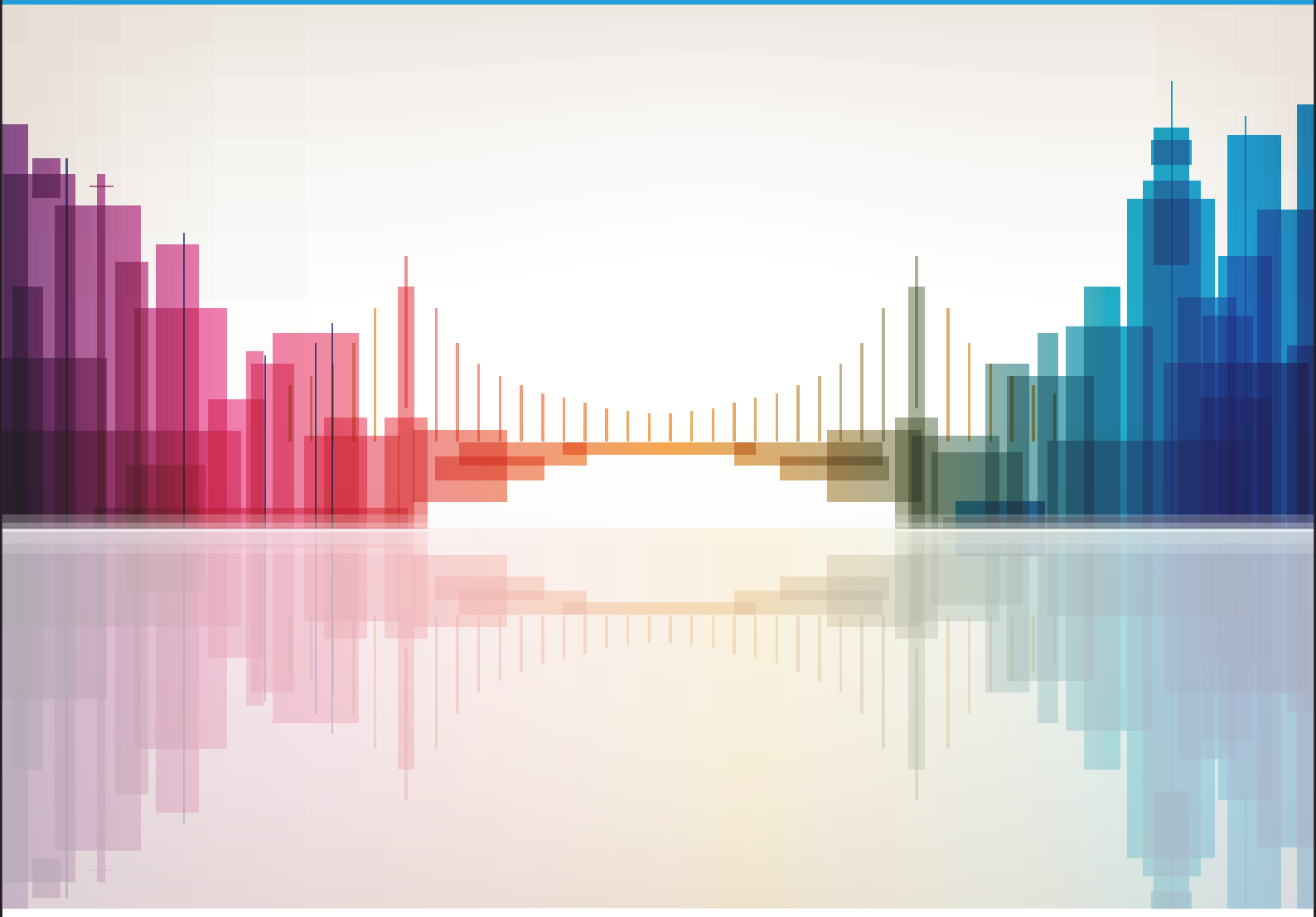
United 4 Smart Sustainable Cities

Factsheet

Bizerte, Tunisia

June 2020



Bizerte Smart City
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ITU

Factsheet

Bizerte, Tunisia

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 Bizerte, Tunisia. This set of KPIs for SSC was 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-assessment.

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Disclaimer

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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 (Recommendation ITU-T Y.4903/L.1603) implemented in Bizerte 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 Bizerte in 2018-2019.

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Abbreviations

ALMP(s)	Active Labour Market Programme(s)
AMB	Barcelona Metropolitan Area
AMC(s)	Micro-Credit Association(s)
AMI	Advanced Metering Infrastructure
CO_2	Carbon Dioxide
DER	Distributed Energy Resources
DRR	Disaster Risk Reduction
EUNIC	European Union National Institutes for Culture
EV	Electric Vehicle(s)
GDP	Gross Domestic Product
GHG(s)	Greenhouse Gas Emission(s)
GIS	Geographic Information System
GiZ	Gesellschaft für Internationale Zusammenarbeit
ICMA	International City/County Management Association
ICT(s)	Information and Communications Technology/ Technologies
ITU	International Telecommunication Union
KPI(s)	Key Performance Indicator(s)
MAP	Mediterranean Action Plan
MENA	Middle East and North Africa (region)
NO_2	Nitrogen Dioxide
O_3	Ozone
OECD	Organisation for Economic Co-operation and Development
PCGD	Municipal Plans of Management of Waste
PHEV	Plug-In Hybrid Electric Vehicle
PM	Particulate Matter ($_{2.5}$ and $_{10}$)
R&D	Research and Development
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
UGPO	Unité de Gestion Par Objectifs
UN	United Nations
UNECE	United Nations Economic Commission for Europe
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 2018, Bizerte, Tunisia agreed to pilot these U4SSC KPIs. This Factsheet documents the key findings of Bizerte'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 Bizerte, with notable KPIs from the three U4SSC dimensions (Economy, Environment, and Society and Culture) providing a clear picture of Bizerte'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, Bizerte 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 Bizerte'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	21	21	91%
Advanced KPIs	22	20	19	86%
Environment				
Core KPIs	12	11	11	92%
Advanced KPIs	5	3	3	60%
Society & Culture				
Core KPIs	19	18	17	89%
Advanced KPIs	10	8	8	80%
Overall				
Core KPIs	54	50	49	91%
Advanced KPIs	37	31	30	81%
Total	**91**	**81**	**79**	**87%**

Bizerte: Key Findings from across the KPIs

- To further optimize a *smart, sustainable ICT infrastructure*, Bizerte should engage with more developed cities and explore their experiences to determine how to implement ICTs and positively impact inhabitants' lives. Bizerte could also utilize Recommendation ITU-T 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', amongst others.

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!

- *Bizerte underperforms in terms of public sector KPIs,* in areas such as developing and making key data sets available online, helping transparency, processing public sector procurement electronically and introducing electronic delivery of public services. It is recommended that Bizerte develops key data sets and makes them available publicly online and starts processing procurement and delivering public services electronically.
- To *foster innovation, utilize community resources and drive economic growth*, Bizerte could work on developing its ICT sector in order to create and retain a larger smart workforce locally. Providing SMEs access to sources of finance and funding, supporting youth-centred innovation and enabling technological advancement across its SMEs landscape will be important for Bizerte's economic future.
- The city could lower its rate of non-revenue water through the employment of best-practice water-loss accounting methods and policies that mandate the 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.
- Bizerte's *electrical supply management* is on its way to becoming effective, but there is some interruption and no reported 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 research the benefits and feasibility of implementing 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. Bizerte could 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'.
- Accessibility to the *public transport* network in Bizerte could be further enhanced. The city could also encourage vehicle-sharing services and carpool programmes as alternatives, along with

greater use of electric vehicles. Traffic anti-congestion measures including adaptive traffic control or prioritasation measures could be deployed by the city.

- In *urban planning* terms, Bizerte has reportedly implemented four of five principles (compactness, connectivity, integration, and social inclusiveness), which put it on its way to becoming a sustainably planned city. The city could benefit from urban development efforts and spatial assessment towards developing greater resilience to climate change. Creating more pedestrian zones and encouraging foot traffic will also help optimize Bizerte's urban planning results.
- An integrated approach to *climate change and air pollution* should be considered, in order to reduce the risks of applying climate-change measures with significant negative impacts on air quality. Bizerte 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 addition to measuring and reporting noise levels within the city.
- In *water consumption* terms, 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 and 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 well as following ITU Recommendations such as ITU-T L.1030: 'E waste management framework for countries', amongst others.
- All cities should optimize the 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. Recommendations 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, some benchmarks are reached thanks to a high adult literacy rate and some positive, health-related outcomes. Nevertheless, there is room for Bizerte to enhance ICT use in classrooms, and track future progress as part of its smart sustainability strategy. The maternal mortality rate should also be further examined to determine the factors involved and progress monitored and reported year on year. The city would also benefit from the adoption of planned electronic health records via a unified, cloud-based system in all hospitals.

- Emergency response times should be calculated and examined in order to have a complete picture of the city's emergency response capability and to gauge the best approach for sustained improvement and effectiveness. 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.
- Bizerte 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)** 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 both 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 more smart and 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 in their move towards 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 to obtain 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 1 pt, 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.

Bizerte and the U4SSC KPI Project

In response to questions on the level of its digital development and sustainability, the **City of Bizerte decided to join this ITU-led project**, utilizing the needs, aims and solutions of the U4SSC. This ambitious project would help Bizerte **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 Bizerte will be able to adapt when developing their own smart sustainable strategies. The KPIs will also help demonstrate how Bizerte is progressing in its achievement of the SDGs. The continuation of the project could also assist Bizerte 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 Bizerte's SSC future.

City Profile: Bizerte, Tunisia

City Profile			
Inhabitants	172 122	**City GDP**	USD 665 423 652
Area	139 km^2	**Household Income**	TND 37 120
Households	36 755	**Inflation Rate**	6.90 %

The City of Bizerte is part of the Bizerte Governorate in Tunisia, located 65 km north of the capital, Tunis. Established since 1100 BC, the area is one of the earliest settlements in Tunisia. Bizerte was also the last town to remain under French control after the rest of Tunisia successfully declared its independence from France in 1963.

Bizerte's rich history is well documented – from its Phoenician origins, to its time under Roman and Byzantine rule, to its enduring Arab legacy and its time as a strategically vital sea-port during the Second World War.

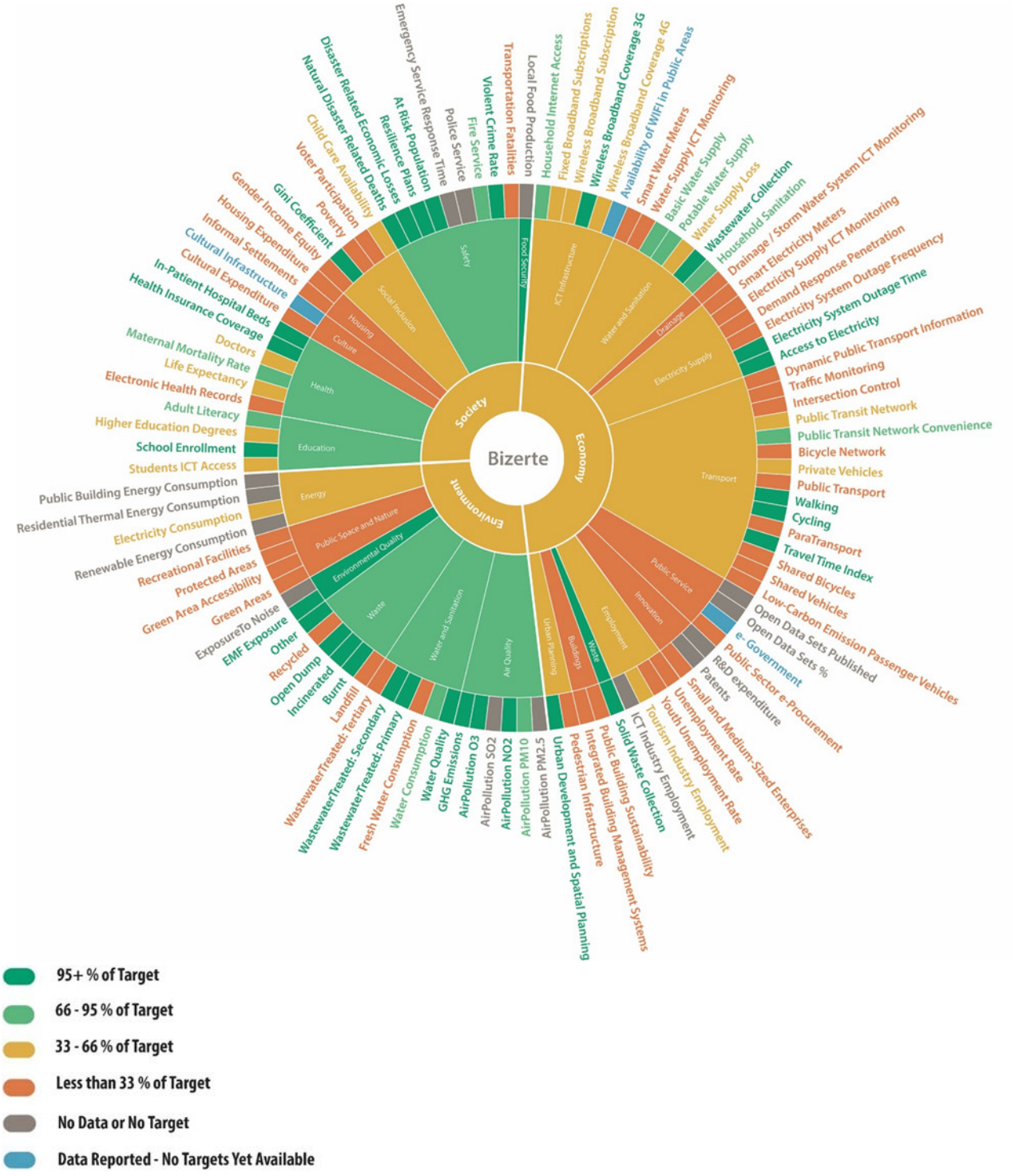
Like other aspiring smart sustainable cities in Tunisia, Bizerte is a remarkable city for study. A unique and marginal zone in terms of its climate, its relationship to Europe and its geopolitical position as an Arab country in Africa, Tunisia provides a fascinating lens through which to study the complex geographical issues of continuity and change in the context of city smartness and sustainability.

Bizerte's demonstrated commitment to its technological and smart sustainable city (SSC) initiatives makes it ideal for the implementation of the U4SSC KPIs for SSC. With the active support of ITU, the first year of Bizerte's U4SSC KPIs project has concluded successfully. The KPIs will also help demonstrate how Bizerte is progressing in its achievement of the SDGs. The continuation of the project could also assist Bizerte in conducting periodic internal reviews of its current ICT-related efforts, thereby allowing the city to benchmark how its ICTs can best be used to monitor and improve its smart city processes and operations. Hence, this project can play a key role in planning Bizerte's SSC future.

Furthermore, the vital knowledge gained from Bizerte's experience will be an important part of ongoing efforts to make not only the U4SSC KPIs for SSC, but also the upcoming Global Smart Sustainable Cities Index, the most effective methods to measure progress and provide guidance to cities on their journey towards becoming smarter and more sustainable.

Bizerte 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.



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.

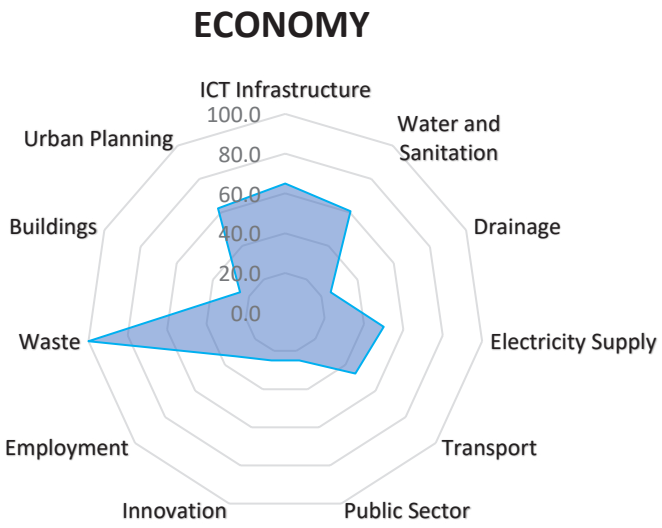
The Productivity sub-dimension includes KPIs related to innovation and employment. These KPIs aim to assess the use and impact of ICTs in the economic development of cities. They cover innovation, job creation, trade and productivity. These KPIs are also expected to play a pivotal role in assessing a city's adoption of the ICTs that support socio-economic 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 Bizerte's KPI performance detailing the categories within the Economy dimension against the current U4SSC benchmarks.



Information and Communication Technology (ICT) Infrastructure

Category	KPI	Result	Performance to Benchmark[1]	SDG
	Fixed Broadband Subscriptions	35.77 %		
	Wireless Broadband Subscriptions (per 100 000 inhabitants)	39 971.65		
	Household Internet Access	85.70 %		
	Wireless Broadband Coverage – 3G	100.00 %		
	Wireless Broadband Coverage – 4G	46.00 %		
	Availability of WI-FI in Public Areas	0.00 Spots	No Benchmark Available	

The analysis of Bizerte's economy starts with its connectivity KPIs.

Mobile internet is prevalent, with 100 per cent of the city served by 3G wireless broadband. Prevalence of 4G wireless broadband, however, remains comparatively lower, at 46 per cent. With no public Wi-Fi hotspots in the city, it becomes even more important to enable the kind of fast mobile internet connectivity that the later generations provide, especially with today's data-hungry mobile applications demanding at least 4G network speeds. And with many developed cities looking to move onto 5G connectivity soon, there is a need, as well as an opportunity, within the city to partner with the private sector to upgrade Bizerte's existing cell towers and related infrastructure to 4G technology – while utilizing the occasion to simultaneously assess and plan for eventual 5G infrastructure.

Residential adoption of internet is high, with 85.7 per cent of the city's households having internet access. The Organisation for Economic Co-operation and Development (OECD) reports that the average household internet penetration rate is approximately 30 per cent around the globe. Bizerte's reported figures are significantly higher than this global average. However, at present, Bizerte has minimal use of ICTs for monitoring and smart city applications.

Optimizing smart, sustainable ICTs: Engagement with more developed cities and their experiences should be explored to determine the best ways to implement ICTs that will have a positive impact on

[1] Benchmark performance is represented by four ranges (1) 0 – 33% of target, (2) 33 – 66% of target, (3) 66 – 95% of target and (4) 95+% of target. The number of coloured circles indicates where the city's data fit into those benchmarks

the city's inhabitants through initiatives such as, for example, the newly offered Claims Area on La Commune De Bizerte's website where citizens can identify and provide input on public issues such as those concerning lighting and roads.

To capture the ICT usage state at that time and to conduct even deeper analysis, Bizerte could utilize Recommendation ITU-T 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 in rural areas, in particular, the Recommendations ITU-T Y.3000 to Y.3499: 'Future networks' can help guide forward-looking implementation.

Public Sector

Category	KPI	Result	Performance to Benchmark	SDG
	Open Data Sets Published	Not Reported	No Benchmark Available	
	Open Data Sets Availability	Not Reported		
	e-Government Services	0.00	No Benchmark Available	
	Public Sector e-Procurement	0.00 %		

Bizerte underperforms in this category. The role of e-governance as a building block to a true smart city has been emphasized by the UN and by the OECD. E-Governance increases citizens' participation in decision making. 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.

Therefore, performance in these indicators needs to be improved significantly.

Optimizing public sector governance, service provision and procurement: It is recommended that Bizerte develops key data sets and makes them available publicly online to help ensure the transparency mentioned above. It is also recommended that the city starts processing its public sector procurement activities electronically. Lastly, the city should introduce electronic delivery of public services in order to achieve the aforementioned effectiveness, accessibility and responsiveness.

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

Innovation and Employment

Category	KPI	Result	Performance to Benchmark	SDG
	R&D Expenditure (relative to GDP)	Not Reported		
	Patents (per 100 000 inhabitants)	Not Reported		
	Small and Medium-Sized Enterprises (SMEs)	75.00 %		
	Unemployment Rate	12.20 %		
	Youth Unemployment Rate	23.30 %		
	Tourism Sector Employment	1.21 %		
	ICT Sector Employment	Not Reported		

While overall levels of unemployment in Bizerte remain lower than national levels, Bizerte's youth unemployment rate is quite high. This, however, is emblematic of Tunisia in general – where, according to the World Bank, young people without work who are no longer attending any school or training programme spend, on average, more than three years searching before finding a job. This trend is even more pronounced for female job seekers.

Optimizing innovation, enhancing employment and driving growth: Development of its ICT sector will help mitigate, to an extent, the issue of youth unemployment in Bizerte. This will have further positive impacts on the economic output and social cohesion, as young people are more likely to be the first to embrace new tools and technologies, as well as be attracted to jobs related to technology and innovation.

Bizerte should also orient any existing Active Labour Market Programmes (ALMPs), for example, towards a more effective provision of employable ICT skills, in order to position its youth to take on such jobs and perform them successfully. The key to unlocking the significant potential that exists within these programmes will be to implement structured monitoring and evaluation systems, facilitate inter-agency coordination, prioritize the recruitment and retention of young women, and expand the beneficiaries of these programmes to include the vast number of unemployed youths who are not university graduates.

Bizerte is also like other Tunisian cities in that the majority of all businesses in the city identify as small and medium-sized enterprises (SMEs). Facilitation of further ICT proliferation and tech enablement across all its sectors is, therefore, all the more important for a city like Bizerte, as research has shown technology to be key in ensuring economic growth in an SME-dominated landscape.

In its detailed comparison of cities with less knowledge-intensive industries to the 'new work' SMEs (creative, digital and professional services), the Centre for Cities found that the former are less economically productive than new work SMEs (which are more tech based and focused). It also follows that since new work SMEs generate more wealth per worker (as the data show), having a higher proportion of these firms is likely to increase the city's overall economic prosperity. New work SMEs also boost demand in other sectors such as administration, retail and leisure (including tourism, in which 1.21% of Bizerte's labour force is currently employed).

Moreover, new work SMEs anywhere, including in Tunisia, are more likely to be started by, or attract, young entrepreneurs. The Atlantic Council concluded that this trend is part of the Tunisian (and broader MENA) region's 'Participation Revolution' in which an engaged young demographic is willing and capable of organically leveraging the vast knowledge and educational tools accessible via the internet, as well as its platform to share ideas and work together digitally to create economic opportunities through entrepreneurship. Fostering youth entrepreneurship can, therefore, also help Bizerte in addressing its rates of high youth unemployment and labour force exclusion.

Another facet vital to the continuation and growth of SMEs is access to sources of finance and funding. Bizerte has the good fortune of being situated in the coastal zone of Tunisia where inclusive financial services are more developed than in rural regions. In recent years, Tunisian policymakers have prioritized the development of micro-credit that SMEs can more easily access. In the Bizerte Governorate, for example, micro-credit associations (AMCs) have, in recent years, taken steps to merge in order to achieve vital efficiencies in scale.

Supporting a culture of accessible financing, youth-centred innovation and technological advancement across its SMEs landscape will be important for Bizerte's future.

Water and Sanitation, Drainage and Waste

Category	KPI	Result	Performance to Benchmark	SDG
	Smart Water Meters	0.00 %		
	Water Supply ICT Monitoring	0.00 %		
	Basic Water Supply	84.37 %		
	Potable Water Supply	84.37 %		
	Water Supply Loss	14.11 %		
	Wastewater Collection	98.38 %		
	Household Sanitation	92.00 %		
	Drainage/Storm Water System ICT Monitoring	0.00 %		
	Solid Waste Collection	100.00 %		

Bizerte's performance in these categories is mixed. The rate of water loss through the water distribution systems warrants evaluation regarding any losses due to the age of the distribution infrastructure. Bizerte should aim to further lower apparent water loss (e.g. customer meter errors, billing system data inaccuracies and unauthorized consumption) and real water loss (e.g. water leakage and storage overflows).

Optimizing water resources, smartly: It is recommended that Bizerte drafts and enacts legislation that mandates conservation of the city's water resources by requiring public drinking water utilities to submit a water conservation plan. Additionally, these utilities should be required to develop ongoing programme(s) of leak detection, repair, and water loss accounting for the transmission, delivery and distribution system, documentation of water pumpage, delivery, sales and loss volumes.

There are also no household smart water meters installed, and there is no ICT-based monitoring of the city's water supply and drainage/storm water systems. It is especially important to address the former. It is recommended that Bizerte mandates the installation of smart meters in homes throughout the city. New smart meters can utilize an advanced metering infrastructure (AMI) system to provide remote meter reading, data analysis and alerts for possible leak or flow problems. This real-time data could help ensure billing accuracy, and allow city staff and residents the ability to detect potential issues and avoid unnecessary water costs.

Deploying ICTs to monitor its distribution systems will also help the city to achieve greater water supply efficiencies.

Several ITU Recommendations and Supplements from ITU-T 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'.

Electricity Supply

Category	KPI	Result	Performance to Benchmark	SDG
	Smart Electricity Meters	0.00 %		
	Electricity Supply ICT Monitoring	0.00 %		
	Demand Response Penetration	0.00 %		7 AFFORDABLE AND CLEAN ENERGY
	Electricity System Outage Frequency	162.00		
	Electricity System Outage Time	65.00 Minutes		
	Access to Electricity	96.37 %		

While most households in Bizerte have an authorized connection to the city's electrical system, a high number of electrical interruptions do occur, with every customer experiencing 162 interruptions on average every year, each of which lasts an average of 65 minutes.

Optimizing electrical supply: It is recommended that the city studies and confirms the factors behind its protracted average outage time, and take steps to reduce the time for each incident. The age, quality and maintenance of the city's electrical infrastructure should be examined.

The installation of household smart electricity meters and introduction of ICTs to monitor its electrical supply systems is recommended for Bizerte, and this will further help the city to reduce any interruptions in the electrical supply. This will also enable the city to move towards, and take advantage of, a more local distributed energy resources (DER) market, which is gathering momentum in some African countries in lieu of expensive grid infrastructure. Developing this demand-response capability will be vital in keeping costs down in the future by providing load reductions during periods of extreme load and curtailing demand on any overstretched and old power generation capacity.

Several ITU Recommendations from ITU-T 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, ITU-T Y.4409/Y.2070: 'Requirements and architecture of the home energy management system and home network services'.

Buildings

Category	KPI	Result	Performance to Benchmark	SDG
	Public Building Sustainability	0.00 %		
	Integrated Building Management Systems in Public Buildings	0.00 %		

The sustainability of human activities in urban areas cannot be addressed without taking into consideration the building, which is the most basic unit that makes up a city.

Optimizing building operations and services: It is recommended, therefore, that Bizerte investigates the use of sustainability certification programmes for on-going public building operations, as these programmes provide a standardized method for optimizing the environmental performance of building stock.

It is recommended that Bizerte measures any public building area that is monitored via automated and integrated building management ICT systems. Buildings with such ICT systems have the capacity to provide a secure living and working environment by ensuring that aspects like energy efficiency and water consumption are maintained at acceptable levels. Such buildings also account for the dynamic utilization of space based on need and availability. It should also adopt energy and water efficiency standards for new buildings, in order to decrease their life cycle environmental impact.

Bizerte should consider implementing Recommendation ITU-T L.1370 'Sustainable and Intelligent Building Services'. This Recommendation sets the minimal requirements for the efficient and sustainable management of the building as a unit. It also defines the services enabled by the sustainable and intelligent building (SIB) concept, the way it contributes to the goals of sustainability, its features, its different possible functioning modes, or its internal architecture and requirements with the IoT node at its core.

Furthermore, ITU-T Study Group 5: 'Environment, Climate Change and Circular Economy' is working on a 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 assess ten key areas of environmental performance and management: Energy, Water, Air, Comfort, Health & Wellness, Purchasing, Custodial, Waste, Site, and Stakeholders.

Transport

SDG Goal	KPI	Result	Performance to Benchmark	SDG
	Dynamic Public Transport Information	0.00 %		
	Traffic Monitoring	0.00 %		
	Intersection Control	0.00 %		
	Public Transport Network (per 100 000 inhabitants)	75.53 km		
	Public Transport Network Convenience	80.00 %		
	Bicycle Network (per 100 000 inhabitants)	0.00 km		
	Transportation Mode Share: Private Vehicles	32.00 %		
	Transportation Mode Share: Public Transport	14.00 %		
	Transportation Mode Share: Walking	43.00 %		
	Transportation Mode Share: Cycling	11.00 %		
	Transportation Mode Share: Para Transport	0.00 %		
	Travel Time Index	1.10		
	Shared Bicycles (per 100 000 inhabitants)	0.00		

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

Although a significant percentage of Bizerte's population has convenient access to public transportation (i.e. within 0.5 km), the implementation of a geographic information system (GIS) can help in making public transportation accessible to all residents. It can also help to provide real-time schedule and information to residents and visitors, which will encourage greater use of the city's public transit system.

While at present, traffic congestion during peak periods does not appear to be a great issue in Bizerte – mainly due to a relatively low presence of cars – ICT integration to manage traffic flow can help minimize the likelihood of future congestion.

Similar results can be achieved through the upcoming national legislation that will allow for shared vehicles. This could have an impact on the way that people get around within and outside the region, leading to it becoming more connected. It would make it easier for travellers, especially tourists, to access areas that are more difficult to get to or are not usually serviced by the public transportation or taxicab options.

Optimizing transport: The most effective approach to future urban planning is to consider the role of ICTs upfront in city development or rejuvenation. All technical, application and market model trends that would have an impact on the infrastructure of the aspiring smart city must be considered. It is recommended that Bizerte develops a master plan for public transport that runs parallel to, and is a component of, the city's master plan. This plan should detail specific strategies and measures to increase the usage of public transport in an environmentally friendly fashion. Bizerte reports no signal-controlled intersections or other traffic monitoring. Therefore, anti-congestion measures, including more adaptive traffic control or prioritization measures, should also be employed by the city. All cities are encouraged to reference ITU-T Y.Suppl.33 to ITU-T Y.4000 series 'Smart Sustainable Cities- Master Plan' as a guideline.

There are many other ITU Recommendations that could also help during formulation of a new or updated transport plan, such as ITU-T Y.1300 to Y.1399: 'Transport' and ITU-T Y.1700 to Y.1799: 'Operation, administration and maintenance'. In private-vehicle-heavy cities, Recommendation 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	0.00 %		
	Urban Development and Spatial Planning: Compact	YES		
	Urban Development and Spatial Planning: Connected	YES		
	Urban Development and Spatial Planning: Integrated	YES		
	Urban Development and Spatial Planning: Inclusive	YES		
	Urban Development and Spatial Planning: Resilient	NO		

To be considered 'sustainable', urban plans should have all of the following five principles/elements, as demonstrated through evidence-based and innovative methodology (including data innovations like spatial analytics, GIS and Big Data):

1) **compactness:** avoiding urban sprawl;
2) **connectivity:** places and locations to demonstrate high connectivity;
3) **integration:** mixed urban land use;
4) **social inclusiveness**; and
5) **resilience to climate change**.

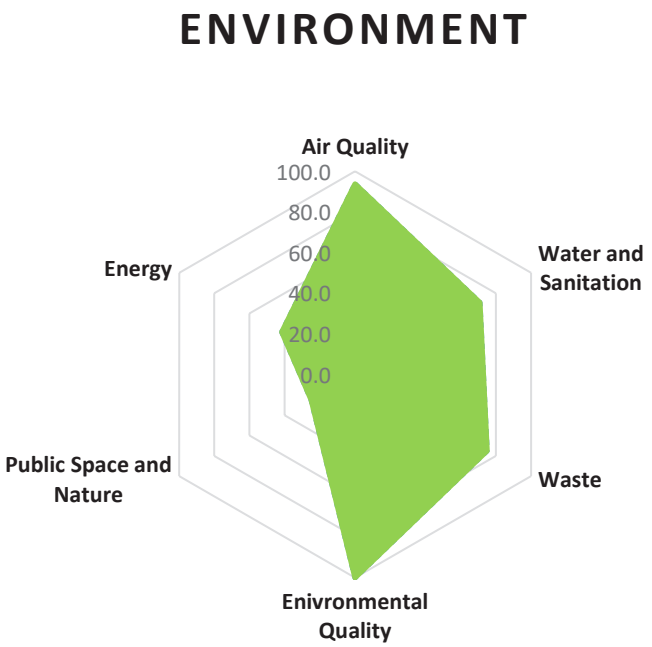
Optimizing urban planning: It is recommended that Bizerte designates a percentage of its city area as a pedestrian/car-free zone. Creating more pedestrian zones will also provide more places for citizens to engage in and create a sense of community. Bizerte should keep in mind community outcomes and their land use planning during the design of 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 Bizerte's long-term environmental sustainability and to that of every other aspiring smart sustainable city.

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



Air Quality

Category	KPI	Result	Performance to Benchmark	SDG
	Particulate Matter ($PM_{2.5}$)	Not Reported		
	Particulate Matter (PM_{10})	38.00 µg/m^3		
	Nitrogen Dioxide (NO_2)	0.02 µg/m^3		11 SUSTAINABLE CITIES AND COMMUNITIES
	Sulphur Dioxide (SO_2)	Not Reported		
	Ozone (O_3)	64.00 µg/m^3		
	GHG Emissions (eCO_2 / capita)	1.23 tonnes		

The region in which Bizerte sits is the most important aquaculture area in Tunisia. Consequently, monitoring its air quality and measuring and reporting any key potential pollutant levels is important. Large particulate matter (PM_{10}) is higher than the 20 µg/m^3 annual mean that the World Health Organization (WHO) recommends as safe. Greenhouse gas emissions (GHGs) were reported to be 1.23 tonnes eCO_2/capita, which is below the Arab World GHG emissions of 4.7 tonnes, and nitrogen dioxide (NO_2) levels are also low.

Optimizing air quality: It is recommended that Bizerte measures and reports small particulate matter ($PM_{2.5}$) and Sulphur Dioxide (SO_2), in order to obtain a complete picture of air quality in the city. 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' 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)	13.65 ha		
	Green Area Accessibility	29.05 %		
	Protected Natural Areas	0.18 %		
	Recreational Facilities (per 100 000 inhabitants)	12 138.48 m^2		
	EMF Exposure	100.00 %		
	Noise Exposure	Not Reported		

It is recommended that Bizerte improves its performance in these categories, especially as it relates to green areas. This is important, as green spaces in urban ecosystems help produce oxygen and naturally mitigate levels of air pollution, including airborne particulate matter. In addition, Green areas not only help cool cities and provide refuge from urban noise, they also help to facilitate physical activity such as walking and cycling, social interaction, recreation and relaxation, thereby helping to improve mental well-being and health.

Optimizing public spaces: Therefore, it is important for Bizerte to ensure that a higher percentage of its population has close proximity to a publicly accessible green space – i.e. lives within 300 meters of one. Although creating green spaces can be a challenge in older or more highly populated cities where there is greater pressure for space, resources and development, it is recommended that Bizerte's plans to introduce more green spaces should ensure that they are distributed uniformly throughout the city area, and that the total area occupied by the green spaces is large enough to accommodate the city's population needs.

Lastly, it is recommended that Bizerte measures and reports noise exposure in the city, because exposure to prolonged levels of noise can lead to negative health effects and adversely affect the ability of residents to enjoy city life.

Water and Sanitation

Category	KPI	Result	Performance to Benchmark	SDG
	Drinking Water Quality	98.98 %		
	Water Consumption (per capita)	86.26 ℓ / day		
	Freshwater Consumption	100.00 %		6 CLEAN WATER AND SANITATION
	Wastewater Treatment: Primary	100.00 %		
	Wastewater Treatment: Secondary	100.00 %		
	Wastewater Treatment: Tertiary	0.00%		

Bizerte performs well in most of these indicators. Its daily water consumption per capita of 86.26 litres is, however, higher than the African average of 53 litres per day.

Optimizing water consumption: It is recommended that Bizerte monitors how much residential and business water demands account for of the city's total water production volumes, evaluates peak day and time water consumption trends, and then sets average annual or daily water production projections and targets based on both customer demand and non-revenue water.

It is recommended that Bizerte reduces its high reliance on freshwater for its consumption needs. The city should incentivize upgrade to more water-efficient appliances and should encourage water conservation through recycling fresh water within homes via greywater re-use systems. Greywater refers to the wastewater from normal usage (as opposed to sewage waste) and can be used for other non-drinking purposes. On the commercial/industry side, Bizerte should support the adoption of new water conservation technologies, encourage improvement in irrigation and support the adoption of agricultural best practices.

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	86.21 %		
	Solid Waste: Burnt	0.00 %		
	Solid Waste: Incinerated	0.00 %		
	Solid Waste: Open Dump	0.00 %		
	Solid Waste: Recycled	13.79 %		
	Solid Waste: Other	0.00 %		

All cities are recommended to prioritize, over all other forms of disposal, solid waste recycling in a regulated facility or solid waste incineration that leads to energy production. It is recommended that Bizerte develops its recycling capability and culture further, which should be a key focus of its future sustainability strategy.

Optimizing waste recycling: As part of this recommendation, other steps that cities or regions such as Bizerte can take to increase their recycling rates include the following best practices:

- Enhance (for non-recyclers) and reinforce (for recyclers) public communication and outreach in order to increase overall public participation in recycling.
- Evaluate the recycling markets and pricing levels for materials.
- Evaluate haulier contract(s).
- Modify collection techniques in order to enhance programme efficiency and diversity as part of a strategic plan.
- Legislate and fund smart recycling.

As increasing generation of e-waste is also a burgeoning issue, ITU-T L.1032: 'Guidelines and certification schemes for e-waste recyclers', along with ITU-T L Suppl. 4: 'Guidelines for developing a sustainable e-waste management system', can be helpful towards cities' efforts to monitor and manage the issue.

Energy

Category	KPI	Result	Performance to Benchmark	SDG
	Renewable Energy Consumption	9.82 %		
	Electricity Consumption (per capita)	2 504.04 kWh / yr		
	Residential Thermal Energy Consumption (per capita)	2 500.00 Gj / yr		
	Public Building Energy Consumption (per year)	Not Reported		

Lastly, Bizerte has reported 2 504.04 kWh electricity consumption per capita annually, which is higher than the neighbouring countries of Algeria (1 450 kWh) and Libya (1 660 kWh), less than the Middle East and North African consumption (2 880 kWh), and in line with the Middle Income Country consumption (2 008 kWh). However, only 9.82 per cent of this electricity consumption is from renewable sources. While this rate is in line with those reported, on average, by OECD countries, sustainable improvements need to be implemented or expanded, in order to include more sources such as solar, wind, hydro, tide and wave energy. It is also recommended that Bizerte analyses its annual residential thermal energy consumption and finds ways to lower it. Bizerte should also measure and report energy consumption in public buildings.

Optimizing energy consumption: To this end, ITU Recommendations that guide modernization and optimization of various public energy use sources should be utilized, including, for example, Recommendations 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', and ITU-T L.1316: 'Energy efficiency framework', along with Supplement 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 a variety of areas, including education, health and societal culture.

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 Bizerte's KPI performance detailing the categories within the Society and Culture dimension against the current U4SSC benchmarks.

Education

Category	KPI	Result	Performance to Benchmark	SDG
	Student ICT Access	56.97 %		
	School Enrollment	95.30 %		
	Higher Education Degrees (per 100 000 inhabitants)	10 849.86		
	Adult Literacy	87.15 %		

While Bizerte reports a high adult literacy rate and school enrollment, access to ICT facilities in classrooms remains lower than in comparable cities in Tunisia. This is possibly as a result of socio-economic disparities among various neighbourhoods to which schools belong.

Urban stakeholders in Bizerte and other aspiring smart sustainable cities are also encouraged to adopt more compulsory e-learning systems for students, and to foster public-private partnerships that will invest in the city's schools, as a way of developing a future economic labour force that is ICT ready and literate. To achieve this, a planned, integrative approach to all levels of education from the government's education department and technology departments is recommended. This means that educators will have to find ways of integrating learning into the ultimate workplace, and not just see ICT education as courses to be taken academically.

Health

Category	KPI	Result	Performance to Benchmark	SDG
	Electronic Health Records	5.82 %		
	Life Expectancy	75.73 yrs.		
	Maternal Mortality Rate (per 100 000 live births)	30.94		
	Physicians (per 100 000 inhabitants)	266.09		
	In-Patient Hospital Beds (per 100 000 inhabitants)	690.79		
	Health insurance / Public Health Coverage	100.00 %		

This set of KPIs signifies positive health-related outcomes for Bizerte's residents, except for its high maternal mortality rate. Although still only half of the Tunisian national figure as of 2015, this is one KPI that needs to be assessed for immediate improvement. It is recommended that the city starts by examining its maternal mortality rate, in order to define the distribution and frequency, and determine the factors involved. These factors should include (but not be limited to): diagnosed cause(s); ease of access to, and affordability of, medical care; geographic zone; maternal age; and any other relevant socio-economic factors. 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.

It is also recommended that Bizerte invests in, or mandates, electronic health record systems at its medical institutions. Doing so can help policy makers gather useful macro data and high-level service delivery and availability related insights that could enable more effective investment to improve its health services.

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	0.16 %		
	Cultural Infrastructure (per 100 000 inhabitants)	4.65	No Benchmark Available	

Bizerte currently spends only 0.16 per cent of its total operating budget on the preservation, protection and conservation of its cultural and natural heritage, including events such as the renowned Summer Festival and the prevailing Mendole Fish (Chawri) Festival. Its cultural institutions include historic sites, such as the Byzantine Fort or Kasbah, its theatre and the Oceanographic Museum.

Cultural infrastructures create environments conducive to the emergence of dynamic and vibrant cultural sectors and clusters as they are a source of cultural, social, as well as economic vitality in the areas in which they are located, especially through tourism. The region in which Bizerte sits in not as popular a tourist centre as the eastern coast of Tunisia. Further investment in its cultural infrastructure and the corresponding development of its tourism industry will lead to positive economic outcomes for Bizerte, and will help alleviate the city's problem of high youth unemployment.

Housing and Social Inclusion

Category	KPI	Result	Performance to Benchmark	SDG
	Informal Settlements	8.88 %		
	Housing Expenditure	42.97 %		
	Gender Income Equity (ratio of Female : Male)	0.74		
	Gini Coefficient	Not Verified		
	Poverty Rate	6.14 %		
	Voter Participation	Not Reported		
	Child Care Availability	34.20 %		

Next are income, equality and housing KPIs.

Bizerte reports an average household income of approximately USD 12 950. The gender income equity of female to male workers is in line with the national data. The rate of poverty is much lower than the national average of around 15 per cent. While several social programmes adopted since the 1970s

have helped to reduce poverty in Tunisia overall, especially in comparison with other countries in the Middle East and North Africa (MENA) region, disparities remain within many Tunisian regions, and even within cities.

Ensuring gender and youth parity and representation: It is recommended, therefore, that Bizerte continues to monitor poverty levels, especially those experienced by its female population, which earns only three-quarters of what the male working population earns.

It is also recommended that Bizerte determines income distribution trends within its working population, again focusing on the levels of equality between genders and between younger and older members of the workforce. To increase gender equity in the areas of employment, participation in management mechanisms, education, health, violence against women and urban services, Bizerte should consider drafting a comprehensive Local Equality Action Plan. The UN Convention on the Elimination of All Forms of Discrimination Against Women and other national plans and international conventions are helpful sources that can provide guidance in this regard. The city should also conduct a gender analysis of its municipal departments, commissions and boards.

Further improving day care availability for children will also lead to greater gender parity in labour market participation. It is recommended that the city increases the number of affordable institutes and facilities available for childcare, while also providing a safe and good learning environment for children. This should go hand in hand with progressive and equality-centred fiscal, wage and social protection policies.

Improving housing affordability: Housing expenditure in Bizerte, as a percentage of total household income, is very high, with a notable percentage of Bizerte's population living in slums, informal settlements or inadequate housing. The constriction of disposable income that arises due to an increase in housing expenditures is referred to as 'housing stress'. In developed countries, a household is typically described as being in housing stress if it is paying more than 30 per cent of its income in housing costs. In OECD countries, in particular, households spend, on average, around 21 per cent of their gross adjusted disposable income on their housing costs.

It is recommended, therefore, that Bizerte takes steps to ensure that the city's prevailing rate of housing expenditure becomes more sustainable. Housing affordability should be prioritized for study as a critical determinant of the living conditions of individuals and households. It should be treated as a relative measure that reflects the balance of income, living arrangements, and housing costs. Any sharp rises in energy prices should also be considered.

Lastly, it is recommended that Bizerte reports its voter participation rate in future years. This is an important KPI as engaging people in decision making through civic voting improves decision quality and inclusiveness with cities, and helps improve on the existing laws and regulations.

Safety and Food Security

Category	KPI	Result	Performance to Benchmark	SDG
	Natural Disaster-Related Deaths (per 100 000 inhabitants)	0.00		
	Disaster-Related Economic Losses (relative to City GDP)	0.00 %		
	Resilience Plans	Not Reported		
	Population Living in Disaster-Prone Areas	0.00 %		
	Emergency Service Response Time	Not Reported		
	Fire Service (per 100 000 inhabitants)	117.94 FTE		
	Traffic Fatalities (per 100 000 inhabitants)	10.46		
	Police Service (per 100 000 inhabitants)	Not Reported		
	Violent Crime Rate (per 100 000 inhabitants)	25.56		
	Local Food Production	91.18 %		

While Bizerte reported no natural disaster-related deaths, no related economic losses and no exposure of inhabitants to living in a zone subject to natural hazards, it is recommended that the city reports whether it has adequate risk and vulnerability assessments for potential disaster mitigation in place that are in line with the Sendai Framework for Disaster Risk Reduction (DRR) 2015–2030.

Finally, it is recommended that Bizerte measures and reports the average response time for emergency services and the number of police officers (per 100 000 inhabitants), so that a complete picture of the city's emergency response capability can be viewed.

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

Bizerte's smart sustainable sister city goals will align with the Digital Tunisia 2020 National Strategic Plan. The plan aims to develop a digital governance and system for Tunisia's industrial and commercial sectors, and to build on the entrepreneurial culture and ICT-based innovation capability in Tunisia. It focuses on four strategic pillars, as explained by the African Development Bank (AfDB):

- **Infrastructure**: Aimed at generalising access to broadband internet and knowledge, and the development of ultra-high-speed internet.
- **e-Governance**: Aimed at transforming government services through the use and adoption of digital technology to enhance the efficiency and transparency of operations for citizens and the business community.
- **e-Business**: Aimed at transforming businesses through digital technology to enhance competitiveness, productivity and integration, as well as making innovation the driving force of the digital industry by developing creative and functional solutions that support all sectors of activity and entrepreneurship.
- **Smart Tunisia**: Geared towards placing Tunisia among the top three countries in Offshoring as well as making it the Leader in IT Offshoring in the African-Middle Eastern region. This applies directly to Kairouan, as – along with Bizerte – it is one of Tunisia's two ITU smart sustainable aspiring cities.

The African Development Bank has agreed to fund a large portion of the project via a loan over the next 19 years as part of the 2063 Agenda for the Transformation of Africa.

A key organization spearheading the effort locally is the Bizerte 2050 Association. Its focus is on maximising the city's smart sustainability progress within a general 2016–2021 five-year plan framework. This is to be followed by road maps every decade until 2050. The Association will help the city and region's stakeholders to set a long-term direction by, in part, leveraging private investments to attract further public investments for Bizerte's SSC initiatives and projects.

The current and future smart sustainable city projects in Bizerte span a variety of areas, for example, from health service delivery to water supply efficiency, from effective waste management to smart infrastructure.

Irrigation and Agriculture Improvements

One such project is being financed by the World Bank, which, in May 2018, announced a USD 140 million project to support the Tunisian Government's focus on irrigated agriculture as a means of managing scarce water resources while creating economic opportunities, especially in underdeveloped rural regions. The project's aim is to finance the repair of irrigation systems, in order to make them more efficient and reliable as the critical input for a more productive agriculture sector that generates greater revenues and provides opportunities for a diverse range of people and enterprises, including women and young people.

One of the regions in which the project will be implemented is the Bizerte Governorate, where the rehabilitation of agricultural irrigation infrastructure will result in a reduction of water loss and ensure consistent water delivery. This increase in water security will increase the volume and value of planted crops. Support in identifying and accessing higher-value crops, as well as markets, will be offered to farmers in order to help them realize high yields. Investment will be made, in order to attract further private investment through matching grants schemes, and in post-harvest infrastructure, which will also increase the value of the area's agricultural production.

Aside from the obvious benefits of water conservation – the development of rural markets, infrastructure and service delivery around the City of Bizerte, and job creation for the region's youth and women – the project will also result in improved food security for the City of Bizerte and its surrounding areas.

Citizen Participation via ICTs

An early World Bank co-funded pilot project in the post-2010 Tunisian era focused on citizen engagement in the accessibility and quality of healthcare in their cities. Co-funded in part by the Korean Trust Fund, various ICT specialists worked with the Ministry of Health in Tunisia to develop and test a new citizen feedback system in hospitals using two types of ICT software: LimeSurvey, which is an open- source tool to create online surveys; and JasperSoft, which is a business intelligence platform used to analyse data collected from a variety of sources.

One of the hospitals chosen was in the semi-rural vicinity of the City of Bizerte. The project's aim was to make the provision and collection of feedback as easy as possible in the pilot hospitals. It included the development of a mobile and tablet-friendly version of the application that allowed hospital staff to elicit and record patient feedback in Arabic and French from any location. In addition, interactive kiosks were installed in the hospital's lobby to enable citizens to provide their feedback independently at any time. The results were then uploaded to a secure website that could be accessed by hospitals and Ministry of Health project managers. This pilot project allowed for automated survey response analysis that included aggregated totals and visual results. It made collecting feedback from thousands of citizens quick, tech friendly and inexpensive. The successful pilot is exactly the type of SSC-relevant initiative that can be introduced or replicated in hospitals across Tunisia.

Waste Management

MedCities joined the Waste Prevention and Management Section of the Barcelona Metropolitan Area (AMB) in implementing a project to improve waste management in two Tunisian municipalities, one of which is Bizerte. The project aims to strengthen the capacities and role of Tunisia's local city governments in waste management and the health of the urban environment, and is based on the work to define the strategic lines carried out by the Municipal Plans of Management of Waste (PCGD), and developed in 2010 by GiZ (*Gesellschaft für Internationale Zusammenarbeit*, which is a German development agency that provides services in international development cooperation).

Bizerte's project is meant to serve as an effective territorial planning tool for all the other similar future municipal interventions in Tunisia. It also seeks to empower citizens with knowledge on the key

environmental aspects related to waste management through public awareness raising. The result is that Bizerte's project enabled the extension of door-to-door waste collection to a new neighbourhood, as well as the elimination of points of uncontrolled waste discharge within the city.

Bizerte's project was divided into three phases. The first phase entailed diagnosis of the then current state of waste management in Bizerte, followed by the prioritization of possible projects, which then led to defining the pilot action to be developed in the city. To this end, a technical mission was carried out in Bizerte. The second phase, i.e. execution, involved: efforts towards improving the provision of the municipal waste services; technical training of the municipal teams; citizen environmental awareness efforts; the introduction of essential technological advances into the city's waste management cycle; an inventory of Black Points; a new programme of waste elimination; and mapping the location of alternative containers. At the conclusion of the last phase of the project, namely the capitalization phase, useful cartographic material on the waste collection system was presented to the city, including information on the collection circuits within the different neighbourhoods of Bizerte, as well as the information on the uncontrolled discharge points within the city.

A GIS map was produced based on the data collected. As part of the GeDeTun project, a three-day training session was held, at the end, for municipal staff from different units, in order to improve their skills and capacity in working with GIS software. Also held was a seminar in which the results of the project were presented and the resulting knowledge was shared with other members of the MedCities network, especially those from Tunisia, with a view to promoting efficient waste management practices and publicizing possible effective interventions that improve the forecast of municipal services.

Working Together and Sharing Knowledge

Such partnerships are essential to Bizerte's success in effectively achieving its smart sustainable city (SSC) goals. Working across public, private and administrative boundaries can help government leaders amplify their influence over economic development, and can help them obtain more from their assets with partners than they would be able to alone. Working together also allows leaders to draw on a complete range of assets within their city, as well as to leverage the assets, scale and expertise from the wider sphere of the working relationship, thereby broadening available opportunities and elevating their level of development.

Aside from the example of network effects resulting from a close working relationship such as with the MedCities network, this conclusion is also reflected in insights from the 2015 Local Government Sustainability Practices Survey by the International City/County Management Association (ICMA). The Survey found that almost 78 per cent of local governments polled indicated that examples of other municipalities are an important and, indeed, key source of information in the move towards the development of their own sustainability strategies.

Another instance of Bizerte's successful leveraging of international SSC platform is its 2017 participation in the MedUrbanTools initiative jointly implemented by UN-Environment, the Mediterranean Action Plan (MAP) and MedCities. MedUrbanTools is a Sustainable Urban Toolbox that aims to provide the necessary resources to ensure that Mediterranean cities are planned cities, inclusive, safe, resilient, and sustainable.

Bizerte was one of thirty-seven cities that contributed knowledge of their own successful experiences to the initiative's knowledge base during the pilot phase of the toolbox development. The knowledge collected for the creation of the sustainable urban toolbox for the Mediterranean will be organized in a database accessible through the MedUrbanTools knowledge-sharing platform.

Bizerte has previously networked with, and served as a host for, the EUNIC Cluster in Tunisia and its Action Workshop project, which was developed on the idea of heritage as an instrument for democracy. Bizerte hosted the July 2012 round-table discussions that promoted the idea of key Cultural Centres as valuable incubators for regional/local initiative. The outcome of this discussion was a commitment to conceive a more ambitious project, developed by EUNIC Global, which would benefit cultural organizations (including public, private and associations) in the Maghreb area and the rest of the Arab world.

With regard to its SSC development, there is also an opportunity for Bizerte to work closely with its strategic partner and twin cities in Africa and Europe, including Tangiers (Morocco), Port Said (Egypt), Annaba (Algeria), Kalamata (Greece), Palermo (Italy), Saint Petersburg (Russia), Rostock (Germany), and Dunkirk and Clermont-Ferrand (France). The last of these has a cooperation agreement with Bizerte for a programme of the rehabilitation of historic centres.

Tourism

An example of a tourism boost project that also dates back to the post-2010 era is the development of a Mediterranean yachting marina at the port of Bizerte. The Goga Superyacht Marina has berths for yachts of up to 110 meters in length. The intended outcome was a boost to the local economy by attracting yacht owners, as well as professional crew year-round, and through the development of service industries that supply the yachts, which has resulted in additional employment in the city.

Bizerte 2050 Projects

The development of SSC-centred mobile applications has also taken off within Bizerte in recent years. At the second Bizerte Smart City conference in 2018 that was organized by the Bizerte 2050 Association – in partnership with Tunisia's Ministry of Communication Technologies and Digital Economy – for example, two highly innovative applications were presented. The first application sought to facilitate the interaction between citizens and the municipal body responsible for city cleanliness, by giving citizens the opportunity to report any cleanliness issues. The other application called *Hafilati* ('My Bus') was made by the Bizerte Regional Transport Company. It is piloting the Bizerte – Tunis Carthage Airport line for online service schedules and station locations.

The Bizerte Governorate, which is the third stakeholder group involved in the City of Bizerte's SSC drive, has announced a laboratory dedicated to the development of a road map for the 'Bizerte Smart City' project spearheaded by the Bizerte 2050 Association.

The Bizerte 2050 Association has drafted comprehensive plans and frameworks to achieve tangible decade-over-decade progress in SSC projects for Bizerte, which include: Smart Bridge (traffic management

and city access; public safety and CCTV); Smart Business City (integrated building management systems and public lighting management systems); Municipal Administration (e-administration; smart public services); Pilot Projects (pedestrian zone; smart parking management; smart urban lighting); Public Transport (adaptive traffic control; management system for integrated mobility management and real-time traveller information); Urban Planning (intelligent housing control; smart grid; sustainable urban design and planning; green urban gardens); Ziper (industrial port zone run via renewable energies); and an International Airport. It also wants to create a Tunisian Smart Cities UGPO to develop, promote and define the Smart City eligibility framework in Tunisia; a SEM (Urban Free-Zone) to implement the Bizerte Smart City programme; an Innovation Centre and start-up incubator to support young people in ICT fields; and leverage the university campus of Menzel Abderrahmene to avail itself of the existing on-site facilities.

Conclusion

This has been the first year of Bizerte's working relationship 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 reached based on Bizerte's experience thus far 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. Bizerte successfully reported 89 per cent of all basic U4SSC indicators and 83 per cent of all advanced indicators as well.
- It is expected that the key findings from Bizerte's experience will also help towards improving the existing definitions of the U4SSC KPIs, in order to enable a smoother data collection process for Bizerte and, potentially, other Tunisian cities in the future.
- Bizerte should build on its first year of reporting the U4SSC KPIs by instituting the mechanisms and through further development of capabilities to quantify, measure, collect and report data relevant to the remaining KPIs not reported in its first year. Bizerte should also adopt the numerous high-level recommendations contained in this report to its specific context, and report data in subsequent years after the implementation of recommended measures. Doing so will also allow for year-over-year progress benchmarking and analytics.
- Bizerte should work closely with other cities in the region on its SSC efforts, in order to leverage any best practices and their shared experiences with developing and instituting smart and sustainable policies and initiatives in the region. Regular knowledge sharing and discussions with ITU members and other international cities are also encouraged.
- Bizerte 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 Bizerte'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 to provide guidance to cities around the world on their journey to becoming smarter and more sustainable.
- Bizerte's reported KPIs will also feed into ITU's new maturity model. The Recommendation ITU-T Y.4904: 'Smart Sustainable City Maturity Model (SSC-MM)' is an additional tool to not only set and measure performance levels of each KPI by Bizerte and other cities, but to also measure the progress of other key dimensions for the development of an SSC, including strategy, ICT infrastructure, data, services and applications and assessments, as further detailed in the box below.

Box 1: Smart Sustainable City Maturity Model

The Smart Sustainable City 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 per cent access, level 4 at 70 per cent access and level 5 at 90 per cent 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.

Bizerte 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.

At this time, 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, 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 10 thematic groups:

- Guidelines on tools and mechanisms to finance SSC projects
- 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 for 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 (UN) 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 that include: 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.

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.

New Urban Agenda

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 in 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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For more information please contact:

u4ssc@itu.int

Website: itu.int/go/u4SSC

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