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Insights into Smart City Market in Turkey

January 2021

Insights into Smart City Market in Turkey

Report commissioned by Korea Trade-Investment Promotion Agency (KOTRA)

OVUS SMARTCITY

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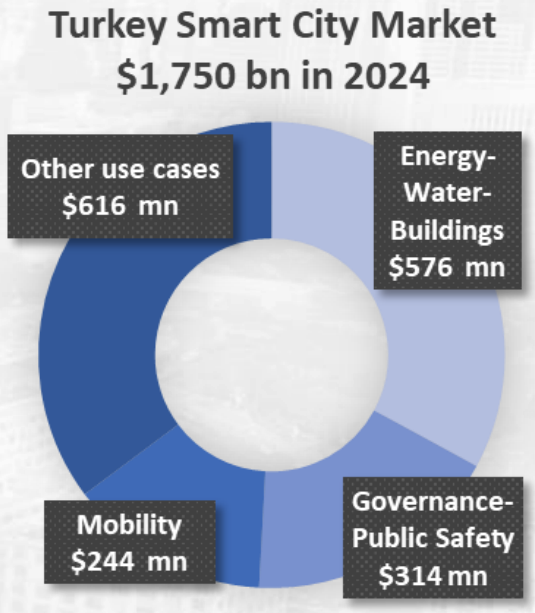
EXECUTIVE SUMMARY

Korea and Turkey have enjoyed a longstanding relationship marked by strong economic, cultural, diplomatic and touristic ties. The bilateral trade volume between Turkey and Korea was around $6.7 billion (TL 52.1 billion) in 2019. Besides expanding bilateral trade volume, Turkey aims to attract more investments from Korean companies.

Even though the history of smart cities in Turkey goes back to 2015, it has been high up on the agenda of the government and the cities in the last 2-3 years with exception of İstanbul (one of the 33 megacities of the world) who initiated its smart city efforts in 2015. Despite this somewhat late start compared to some European, American and Asian countries, after the publishing of the "2020-2023 National Smart Cities Strategy and Action Plan" at the end of 2019, the interest in smart cities has grown tremendously from cities of all sizes.

Meanwhile, COVID-19 seems to have accelerated digital transformation and analysts predict that overall smart city investment will reach $203 billion globally by 2024 (IDC, 2020b). This translates to a Turkish smart city market of approximately $1.750 billion in 2024.

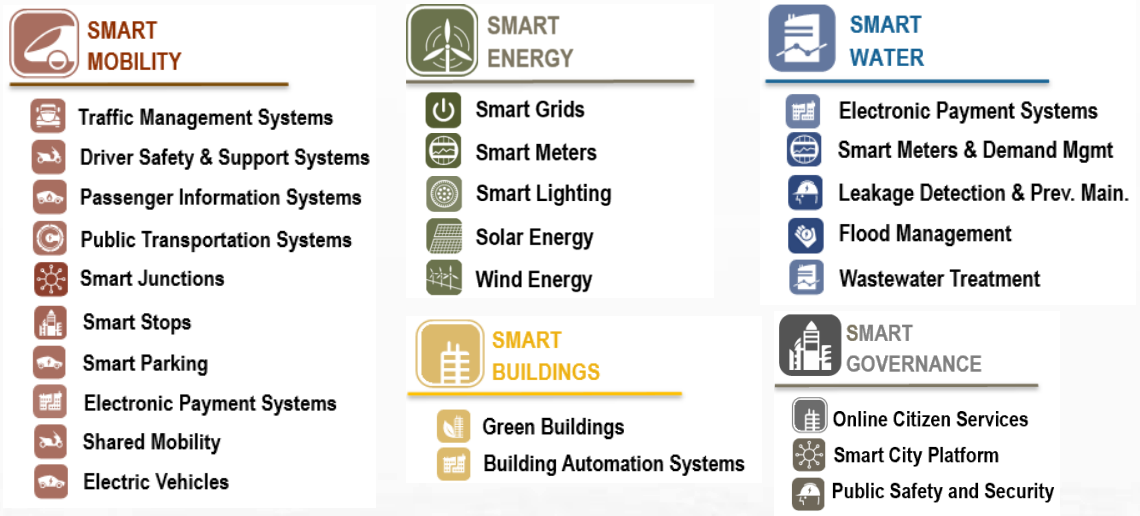
This study analyzes the Turkish smart city market in terms of use cases that are grouped under 5 main industries namely smart mobility, smart energy, smart water, smart buildings and smart governance-public safety. The shares of these industries in the 2024 smart city spending are expected to be $244 for mobility, $576 million for smart buildings, resilient energy & water infrastructure and $314 million for public safety/governance.



Among the 25 use cases analyzed within the Turkish context, energy use cases appear to have good potential particularly smart grids and meters. Solar and wind energy has had successful big tenders and this growth is likely to continue with series of smaller tenders as energy is one of the most strategic sectors for Turkey.

Another industry with high potential use cases is smart mobility. Intelligent Transportation Systems have enjoyed strong growth that is expected to continue in the coming years with Traffic Management and Public Transportation Systems. Meanwhile, shared mobility and electrified vehicles have been showing their potential in large cities and are at the start of a growth curve especially considering the effects of the Covid-19 on the mobility industry.

The 25 smart city use cases identified as being most relevant for Turkey are listed below:



Climate change has been putting a strain on Turkey's water resources already for a while and cities are pressured to improve their networks with smart solutions as water and sewage administrations are under the responsibility of metropolitan municipalities. Flood management is another important area of focus that needs to be addressed by use of technology.

Being a construction driven economy for years, building automation systems and green buildings have potential to grow in the coming years. While Turkey is among the top tier countries when it comes to e-services for citizens, due to its geographical conditions public safety and security still has room for growth. Video surveillance and biometric authentication are expected to receive more attention by the cities and the ministries in the coming years even though considerable investment has already been done.

An important challenge of Turkey is being located on main earthquake fault lines. Earthquakes inflict the most losses among natural disasters in Turkey which makes emergency response systems a priority for government organizations and cities. Use of information and communication technologies effectively in dealing with such natural disasters is an important priority for Turkey.

The study also provides background information on the evolution of smart cities in Turkey, including government plans, initiatives undertaken and examples of smart city projects. The report features 10 cities that have already started their transformation efforts, providing brief information on the city and examples of projects. These cities which together constitute about two thirds of Turkey's GDP are likely to lead smart city demand in near future while other cities are expected to form a pipeline of potential projects. It should also be noted that around 70% of the smart city opportunity lies within cities that are spending $1 million or less per year (IDC, 2020a). The map shows the featured cities in the report in color.

Featured cities in the study

As financing and funding smart cities is often a challenge while implementing such projects, different alternatives have been analyzed from the Turkish perspective, providing an array of solutions ranging from government funding to institutional financing, from innovative revenue models to procurement-based models.

The report also outlines smart city market development strategies for organizations of different natures from simple ones to more sophisticated ones, also including some non-traditional alternatives including important trade shows and events in Turkey for the 5 smart city industries analyzed.

INTRODUCTION

This study commissioned by KOTRA aims to provide insights into the Turkish Smart City market, potential opportunities, funding/financing alternatives and market development strategies. Five smart city industries have been identified as the scope the study with a total of 25 use cases: **Smart Mobility, Smart Energy, Smart Water, Smart Buildings** and **Smart Governance**. The report provides an outlook for each one of them within the context of Turkey in terms of considerations for market development in the existing environment and in the years to come.

Background

The world's population has been increasing steadily. While there are 7.7 billion people in the world, it is expected that the world population will reach 8.5 billion in 2030, 9.7 billion in 2050 and 10.9 billion in 2100 according to the World Population Prospects 2019 (INED, 2019).

There will be 43 megacities with more than 10 million inhabitants by 2030 according to UN's predictions (WEF, 2019). In spite of the rise in world population, cities occupy only 2% of the Earth's surface while they consume over two-thirds of the world's energy and account for more than 70% of global CO2 emissions (C40 Cities, 2020).

General Information

Turkey is a member of the United Nations (UN), Organization of Islamic Cooperation (OIC), Organization for Economic Co-operation and Development (OECD), Organization for Security and Co-operation in Europe (OSCE) and a member state of the Council of Europe and NATO.

Since 2005, Turkey is in accession negotiations with the European Union. The negotiations have been launched with the adoption of the Negotiation Framework by the Council of the European Union.

Turkey's population stands at 83,154,997 while half of the population is below the age of 32 and the proportion of population of the cities is 92.3%. The number of people living in the megacity of Istanbul is 15,067,724 and most populated cities after İstanbul are Ankara, İzmir, Bursa and Antalya.

The highest population density in Turkey is within the Marmara region with approximately 25 million people where İstanbul is situated. Central Anatolia region that also includes nation's capital Ankara follows Marmara with an approximate population of 13 million. The Mediterranean Region ranks third with a population of approximately 11 million. One of the reasons why Marmara region is so populated is because of domestic and international immigration, due to Istanbul serving as the commercial center of the country, generating almost a third of Turkey's GDP and Marmara region about 45% of GDP. Figure 1 shows Turkey's population density map, where darker colors indicate higher density:

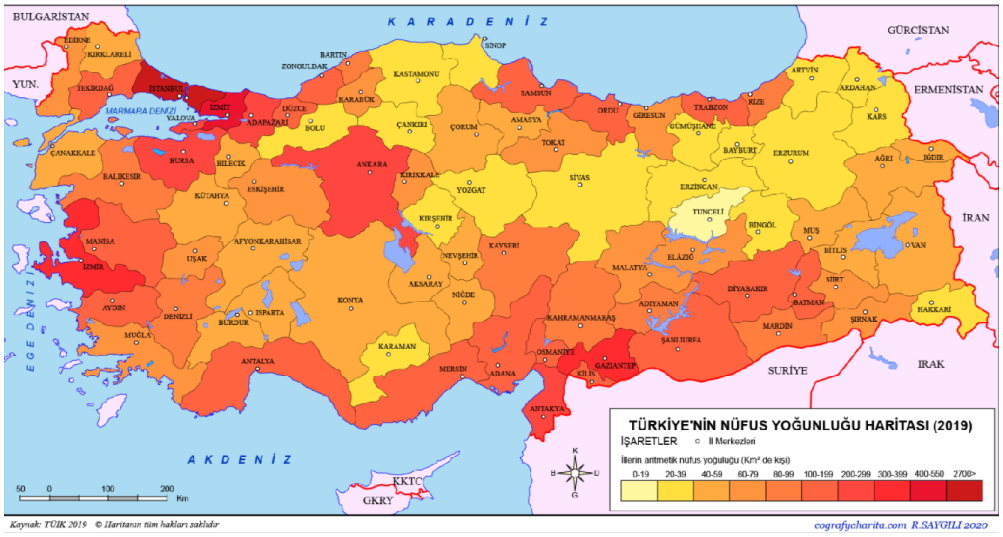


Figure 1 – Turkey's Population Density Map (Turkstat, 2019)

Municipalities

The below table shows the distribution of Turkey's population by cities grouped and ranked by size (MoI, 2019). The first 30 cities up to and including Erzurum are also known as **Metropolitan Municipalities** which account for nearly 78% of Turkey's population and all these cities have more than 750.000 as population. Where 30 provinces have the metropolitan system, their responsibility cover the whole of their provincial boundaries.

For the remaining 51 provinces of Turkey, the **Provincial Municipality** covers only the central district. Local services in these provinces are usually delivered by municipalities in the urban areas (central districts) and by special provincial administrations in the rural areas (other provincial districts). Special provincial administrations are additionally in charge of such public services as agriculture, livestock, sports, culture and education within the remit of the central government in the entire province including municipal areas (TBB, 2020).

15.000.000 1.000.000	1.000.000 500.000	500.000 250.000	250.000
İSTANBUL	SAKARYA	GİRESUN	KARAMAN
ANKARA	MUĞLA	ISPARTA	YALOVA
İZMİR	ESKİŞEHİR	MUŞ	KARABÜK5
BURSA	MARDİN	YOZGAT	KIRŞEHİR
ANTALYA	MALATYA	AKSARAY	ERZİNCAN
ADANA	TRABZON	EDİRNE	SİNOP
KONYA	ORDU	DÜZCE	BİLECİK
ŞANLIURFA	ERZURUM	KASTAMONU	IĞDIR
GAZİANTEP	AFYON	UŞAK	BARTIN
MERSİN	ADIYAMAN	NİĞDE	ÇANKIRI
KOCAELİ	SİVAS	BİTLİS	ARTVİN
DİYARBAKIR	BATMAN	KIRKLARELİ	GÜMÜŞHANE
HATAY	ZONGULDAK	RİZE	KİLİS
MANİSA	ELAZIĞ	SİİRT	ARDAHAN
KAYSERİ	TOKAT	AMASYA	TUNCELİ
SAMSUN	KÜTAHYA	BOLU	BAYBURT
BALIKESİR	OSMANİYE	NEVŞEHİR	
KAHRAMANMARAŞ	AĞRI	KARS	
VAN	ŞIRNAK	HAKKARİ	
TEKİRDAĞ	ÇORUM	BİNGÖL	
AYDIN	ÇANAKKALE	KIRIKKALE	
DENİZLİ		BURDUR	

Economic Outlook

Turkey is the 19th largest economy in the world and based on its 2023 vision it aims to be in the top ten economies of the world by the year of the 100th anniversary of the Turkish Republic. According to Turkish government statistics by Turkstat, the Turkish economy grew 0.9% in 2019, indicating a decrease from prior years' growth. Turkish economy's growth is generally attributable to PPP infrastructure projects such as new housings, highways, hospitals and airports. The difficulties of economy have been accelerated by the COVID-19 pandemic situation which is still being the most challenging issue that has the highest impact on the economy.

Foreign Trade

OECD data indicates that global foreign direct investment (FDI) has declined by 27% to 1.097 billion in 2018. This represents 1.3% of global GDP, the lowest level since 1999. Despite the bleak outlook regarding global FDI, Turkey saw an annual increase of 14% in direct investment, according to the Presidency of the Republic of Turkey Investment Office (KPMG, 2019). In terms of its geographical and geopolitical location, being at the crossroads of Europe, Asia and the Middle East, Turkey presents various opportunities for many of the foreign investors.

Korea and Turkey have enjoyed a longstanding relationship marked by strong economic, cultural, diplomatic, and touristic ties. The bilateral trade volume between Turkey and Korea was around $6.7 billion (TL 52.1 billion) in 2019. Besides expanding bilateral trade volume, Turkey eyes attracting more investments from Korean companies, Turkish Trade Minister said, at the Turkey-Korea Business and Investment Meeting Forum organized by Turkey's Foreign Economic Relations Board (DEIK) and the Korean Chamber of Commerce and Industry, on September 22nd, 2020. She also stated that, "We expect concrete steps from Korea to ensure that the two countries can develop their bilateral trade ties with a win-win principle, in a balanced and sustainable manner.", also pointing out the trade gap.

One of the recent engagements between the two countries has been with regards to building of the world's longest suspension bridge once completed. The Çanakkale 1915 Bridge has secured a €2.3 billion loan, 70% of which came from foreign financial institutions. The largest loans for the project, which has been contracted to Turkish and Korean firms, came from Korean export credit agencies.

Turkey is EU's 4th largest export market and 5th largest provider of imports. The EU is by far Turkey's number one import and export partner. Imports into Turkey come from the following key markets: the EU (32%), Russia, China, USA, India and Korea, the latter reaching €5.1 billion in 2019 (European Commission Trade, 2019).

Turkey has been preferred by foreign investors for reasons such as below:

- Strong economic growth: with an average annual GDP growth rate of 5.5%
- Large domestic and regional market: Sizeable domestic market and regional markets with FTAs allowing access to 1 billion consumers
- Strategic location: Regional HQs for multinationals with ease of global connectivity
- Favorable Demographics: Young and dynamic population with half under 32 years of age
- Skilled and Cost-Competitive Labor Force: Well-educated, cost-competitive labor force

BACKGROUND TO SMART CITIES IN TURKEY

Overview

History of smart cities in Turkey goes back to 2015 and it has moved higher on public agendas in the last 2-3 years with exception of İstanbul who initiated its smart city efforts in 2015. Despite the fewer number of projects compared to other countries, the interest in smart cities has grown tremendously among cities of all sizes.

Several cities have already introduced smart applications in various areas, particularly in transportation-mobility fields. Urban services delivered through internet and e-municipality services are quite popular among cities. On the other hand, smart applications in the areas of energy and water management are still strongly needed. Supervisory Control and Data Acquisition (SCADA) and GIS applications are used particularly by electric utilities, water and sewage administrations in major cities while smart metering is still in its early stages.

Other high level policy documents such as National Development Plan, the Five Years Development Plans, the Medium-Term Plans and the Strategic Plans of the Ministries which are guides for investments, priorities, and incentives have been referring to smart cities already for some time as below:

Period	Strategic Plans & Actions of Turkey relating to Smart Cities
2020-2023	National Smart Cities Strategy and Action Plan
2020-2023	National Intelligent Transportation System (ITS) Strategy and Action Plan
2019-2023	11th Development Plan
2023	Turkey Transport, Maritime and Communication Strategy
2019-2021	New Economy, Medium Term Program
2017-2020	National Broadband Strategy and Action Plan
2016-2019	National e-Government Strategy and Action Plan
2015-2018	Information Society Strategy and Action Plan of Turkey
2012-2023	Energy Efficiency Strategy
2011-2020	Climate Change National Action Plan
2010-2023	KENTGES-Integrated Urban Development Strategy and Action Plan

National Smart Cities Strategy and Action Plan of Turkey

With the vision of "Livable and Sustainable Cities that Add Value to Life", the national plan is a new transformation process for all the cities in charge of the needs of citizens by adopting inclusive governance approaches through efficient resource utilization. This vision is supported by two strategies:

- Competent and productive smart city eco-system
- Efficient and sustainable smart city governance

Furthermore, under this vision, 4 strategic goals, 9 objectives and 40 actions have been defined while a maturity evaluation model and a monitoring and evaluation model is to be developed by MoEU (Figure 2). As a consequence of this national plan, the government has asked all cities with a population of 50.000 and above to prepare a local smart city strategy and roadmap until 2023.

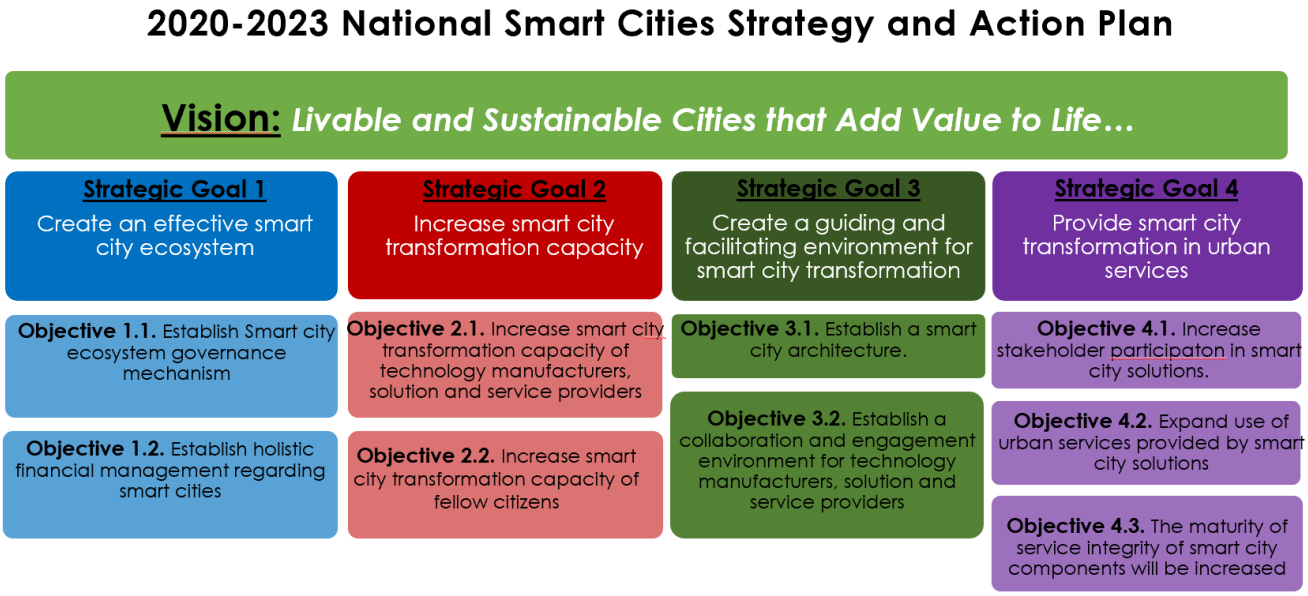


Figure 2- Turkey's National Smart City Strategy and Action Plan 2020-2023 (MoEU, 2019)

Smart City Research in Turkey

A smart city ecosystem is built upon collaboration and co-operation of its citizens and related stakeholders to create a citizen centered approach for the realization of smart cities. These stakeholders typically include public organizations, non-governmental organizations (NGOs), private companies, knowledge institutions, and startups. Some of these stakeholders have already been involved in smart city initiatives by participating into various research and a list has been provided below:

Year	Research Title	Published by
2016, March	Turkey Smart City Assessment Report	TBV, Mastercard, Novusens, ITU
2016, December	Turkey Smart City Road Map	Vodafone, Deloitte, TBV
2017, November	Çanakkale Smart City Transformation Report	Kale Group, TBV, Novusens
2019	Smart City White Paper	Ministry of Environment and Urbanization
2019, January	Smart City Approach and Possibilities for Implementation in Turkish Metropolitan Cities	Master Thesis, Social Sciences Institute at Hacettepe University by Oğuzhan Gürsoy
2019, March	Policy Approach and Action Plan for Smart Cities	MBB (Marmara Union of Municipalities)
2019, March	UK-Turkey Smart Mobility Report	British Embassy, Novusens Smart City Institute, UK Transport Systems Catapult
2019, September	Mapping out Smart City Initiatives in the Turkish Context	Master Thesis, City and Regional Planning Department, METU by Deniz Can
2019, October	A Study on Smart City Systems in Turkey	Master Thesis, Faculty of Architecture, Istanbul Aydin University-Amir Mirghaemi
2019, November	Partnership for Future of Smart Cities, Çanakkale-Tarragona, Spain	Municipality of Çanakkale & Tarragona, Smart City Foundation of Tarragona, TBV, Novusens Smart City Institute
2020, January	Smart City Policies and Analysis of Local Applications	Master Thesis, Social Sciences Institute, Ankara University by Tülin Karaer
2020, March	UK-Turkey Open Data and Smart Cities Report	British Embassy, Novusens Big Data Institute, UK Open Data Institute
2020, September	Application of the 'Smart' to the City, A Critical Evaluation: The Case of Turkey	Doctoral of Philosophy, City and Regional Planning, METU by Gülnar Bayramo Barman

Smart City Initiatives Supported by Third Countries

This section provides information regarding smart city initiatives in Turkey which are directly funded by other countries, excluding EU funded calls whose recipient is not necessarily Turkish organizations.

-US Trade Development Agency Next Generation Cities Initiative

U.S. Trade and Development Agency (USTDA) has launched the U.S.–Turkey Next Generation Cities Initiative to support the development of smart cities across Turkey. Below is a summary of smart city related projects funded by USTDA.

Pilot project to improve roadway congestion and optimize public transportation (Sept. 2020)

USTDA awarded a grant to Istanbul Metropolitan Municipality in support of a pilot project to improve roadway congestion and optimize public transportation in the city. The grant funding is estimated to be $5 million.

Technical Assistance: Gaziantep Smart City Roadmap Grant Program (June 2020)

This Technical Assistance (TA) aims to help the development of a smart city roadmap for the Gaziantep Metropolitan Municipality as it prioritizes new investments, services and applications to enhance city operations, public services and quality of life. The grant's value is $750,000.

Pilot Project to optimize bus route planning in Ankara (June 2020)

USTDA pilot project will help Ankara's General Directorate of EGO optimize bus route planning across the city. The pilot includes installation of a customized AI-based software platform, development of a mobile application for tracking bus transportation data and a program to improve network efficiency and effectiveness.

Technical Assistance to develop 'smart campus' project at METU (September 2017)

Smart Campus' cooperation between the Middle East Technical University (METU) and the USTDA aimed to develop a road map for the efficient use of energy, transportation, construction and water management at METU through a grant of $830,000.

Technical Assistance for Istanbul Smarter City Initiative (August 2015)

Technical Assistance (TA) aimed to improve city operations, enhance crisis and disaster management, and provide efficient and reliable public services for the citizens of Istanbul amounts to $673,000.

-UK Prosperity Fund - Future Cities Program

The program covers 19 cities in 10 countries (Turkey, Brazil, South Africa, Nigeria, Indonesia, Malaysia, Philippines, Thailand, Vietnam and Burma). Turkey value of the program is £10mn or approximately $13.3mn) split among three cities, İstanbul, Ankara, Bursa, launched in September, 2019.

Projects jointly determined and designed with stakeholders within the scope of the Program are:

- Transforming Bursa into a Smart City
- Developing Sustainable Urban Transformation Approach for Bursa
- Increasing Quality and Accessibility of Streets in Çankaya Neighborhoods in Ankara
- Bicycle Strategy, Master Plan and Pilot Implementation for Integrated Non-Motorized Multimodal Transport in Ankara
- Sustainable Urban Mobility Plan (SUMP) for Istanbul
- Urban Planning Training and Capacity Development Program for Resilient Istanbul

-Creative Industries Fund of Netherlands

Creative Industries Fund NL is the Dutch cultural fund for architecture, design and digital culture. The Fund aims to make a substantial contribution to the quality of professional design practice within and especially between the disciplines of architecture, design and digital culture.

The fund has provided 3 grants recently in Turkey for the below projects:

- Cycling for a Better City: A roadmap for designing an inclusive Bicycle Masterplan
- Toroslar Interactive CityLab
- Turkish and Dutch Farming Practices Learn from Each Other

FEATURED SMART CITY PROJECTS IN TURKEY

As there are no smart city indexes for Turkey yet, competitiveness indexes can still provide some guidance on the capacities of cities. One example is the Competitiveness of Turkish Cities Index conducted by Istanbul University between 2018 and 2019. Istanbul, Ankara, İzmir and Kocaeli cities have been ranked at the top of the list respectively followed by Antalya, Bursa and Eskisehir. Figure 3 shows the competitiveness of Turkish cities where darker colors indicate higher competitiveness:

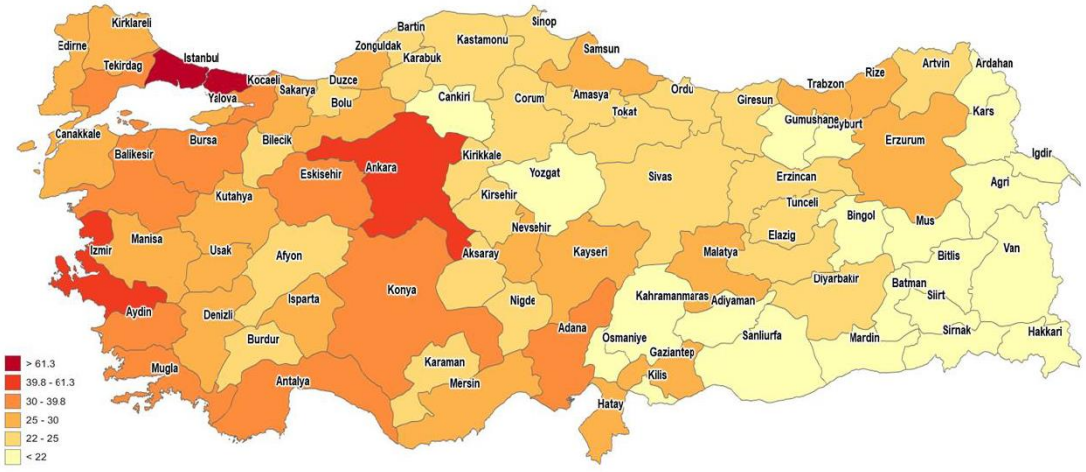


Figure 3- Competitiveness Index of Turkish Cities Map (Istanbul University, 2020)

According to another study done by TEPAV, below are the top 10 cities ranked by GDP which account for two thirds of Turkey's GDP (TEPAV, 2019).

CITY	İstanbul	Ankara	İzmir	Bursa	Kocaeli	Antalya	Konya	Adana	Gaziantep	Mersin
% Turkey GDP Share	%31.2	%8.9	%6.2	%4.1	%3.8	%2.9	%2.1	%2.0	%1.8	%1.8

Several cities in Turkey have been developing smart city initiatives and applications particularly on e-municipal services, smart mobility, smart energy, water and the like. According to a study, among the objectives of municipalities for realizing smart city applications, improving lives of citizens is by far the most important objective, followed by resource saving purposes and environmental concerns (Novusens, 2016).

Cities that have had head start in their smart city transformations include Istanbul, Ankara, Bursa, İzmir, Gaziantep, Antalya, Konya, Kocaeli, Eskişehir-Tepebaşı and Çanakkale, while many other cities have also begun their smart city journeys. In the following sections, brief information will be provided on featured cities regarding their smart city efforts:

İstanbul - Ankara - İzmir - Bursa - Kocaeli
Antalya - Konya - Gaziantep - Çanakkale - Eskişehir Tepebaşı

İstanbul

Despite recent volatility, Turkey's economic center İstanbul generates about 31% of Turkey's GDP (TEPAV, 2019) and hosts about 20% of the whole population of Turkey with a density of 2,919 people per square kilometer and therefore it has lots of challenges like rapid urbanization and scarcity of resources. Istanbul being one of the 33 megacities of the world has been leading the smart city efforts in Turkey by implementing a variety of smart city solutions.

İstanbul Metropolitan Municipality (İMM) started a comprehensive smart city transformation initiative and roadmap in 2015 with its related companies like İSBAK. İMM is the first municipality to have an active Directorate of Smart City to achieve an integrated governance of smart city implementations (METU, 2019).

Smart City Vision of Istanbul developed within this transformation project is; "to be the smartest city in the world that makes the most contribution to the quality of life by 2029" along with short (2019), medium (2023) and long (2029) term strategic objectives and smart city roadmap. Eight focus areas have been identified as "mobility, environment, energy, governance, economy, life, human and safety".

Selected Smart City Projects by İMM include but not limited to below (METU, 2019):

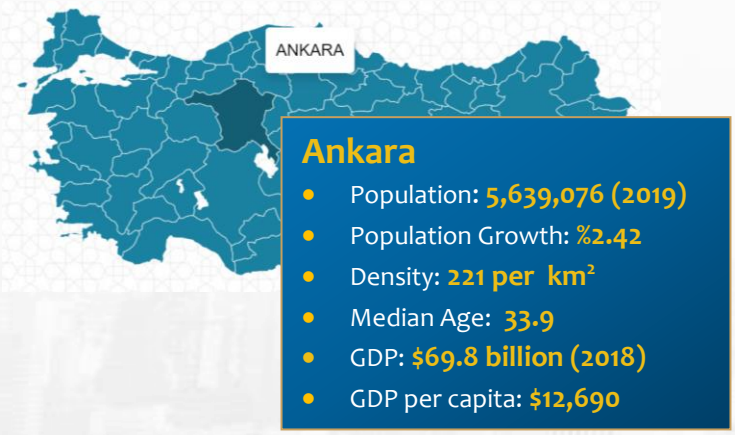
İstanbul Smart City Projects	İstanbul Smart City Projects
Smart Meters	Smart Container (Solid Waste Separation)
İSKİ Scada System	Air Quality Monitoring Center
Traffic Control Center and Fully Adaptive Traffic System	İSBİKE Bicycle Sharing Program (140 Stations)
İSPARK – Smart Parking Management	Environmental Control Center (Waste)
Mobile Apps for Transportation, Urban Services, City Guide, Tourism	UYM (Transport Management Center)-Traffic Big Data Used for Passenger Information Systems Etc.
EDS-Electronic Detection System (Speed, Light…)	Büyük Çekmece Lake Floating Solar Power Plant
Smart Public Transport and Smart Stations	Domestic Waste Incineration and Power Generation Facility (Ongoing)
Smart (İstanbul) Card for Mobility Payments	Zemin İstanbul R&D Innovation Center
Başakşehir Living Lab	

İstanbul Metropolitan Municipality (İMM) was awarded grants by USTDA and UK Prosperity Fund Future Cities Program as mentioned earlier in the section "Smart City Initiatives supported by 3rd Countries". The city also has a vibrant startup eco-system supported by Zemin Innovation Center and Başakşehir Living Lab.

Ankara

Ankara, capital city of Turkey, is the second most populous province with its 5.6 million residents; and with 25,402-km2 of area, it is the third largest province in the country. Ankara has a high number of universities when compared to most cities in Turkey and hosts some of Turkey's prominent Technoparks. Moreover, the ratio of university graduates is twice the national average. This educated population constitutes the labor force required by technology-based investments. Ankara comes first in the defense industry, software and electronics sectors in Turkey.

Some of the applications and projects implemented in the city of Ankara that facilitate urban life and improve the quality of life are City and Traffic Cameras that are used to both manage the traffic and provide safety within the city; the Intelligent Transportation System that includes traffic information, displays, signaling system for Central Junction Control, Dynamic Junction Control System and mobile and web traffic density maps.



Moreover, the city has Environmental projects such as Integrated Solid Waste Management System, Smart Water Management Systems (METU, 2020). The city's smart card, AnkaraKart is used on suburban rail, metro and bus services to make payments.

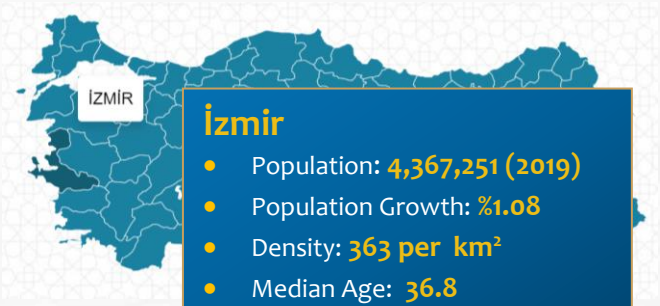
Selected Smart City Projects by Ankara Metropolitan Municipality include but not limited to below (METU, 2019):

Ankara Smart City Projects	Ankara Smart City Projects
Integrated Solid Waste Management Systems in Mamak And Sincan Districts	Smart Water Management Systems (SCADA) And Smart Water Meters
Zero Waste Program in Municipal Institutions	Smart Public Transportation Systems
Electric Energy Tracking System (ETS) In Public Facilities	Information Access and Technology Education Center
Smart Transportation Systems (Passenger Information Systems, Junction Management etc.)	Mobile Apps for Transportation, Urban Services, City Guide and Tourism
Meteorological Data Tracking System	Free Wifi Services

Ankara Metropolitan Municipality was awarded grants by USTDA and UK Prosperity Fund Future Cities Program as mentioned earlier in the section "Smart City Initiatives supported by 3rd Countries".

İzmir

İzmir is the third most populous city of Turkey with its 4.3 million population in 12,016-km2 area with a density of 363 people per square kilometer. The city is a trade and port city since ancient times and its GDP is estimated as 6.2% of that of Turkey (TEPAV, 2019).



İzmir

- Population: **4,367,251 (2019)**
- Population Growth: **%1.08**
- Density: **363 per km²**
- Median Age: **36.8**
- GDP: **$48.5 billion (2018)**
- GDP per capita: **$11,220**

It manages more than 10,000 smart devices and has the longest fiber-optic network since 2017 in Turkey with 621 thousand meters fiber optic cable within the scope of IzmirNet Project and Intelligent Traffic Systems. In addition to the mobility development, Izmir also has wastewater treatment plants, solid waste disposals, which are supported by Solar panels, installed on 10,000 m2 roof area in the workshop buildings of ESHOT General Directorate, eco-lighting systems in public spaces as Environmental Projects (METU, 2020).

The use of electrical bus fleet within ESHOT (subsidiary of Izmir Metropolitan Municipality) started in 2017 and within 1-year time 1823 tons of CO2 emission has been prevented according to ESHOT (METU, 2019). Meanwhile, IzmirimKart is valid on cable car, waterborne, suburban rail, metro, tram, LRT, and bus services.

The city's startup eco-system has been flourishing and it has been attracting young entrepreneurs in recent years.

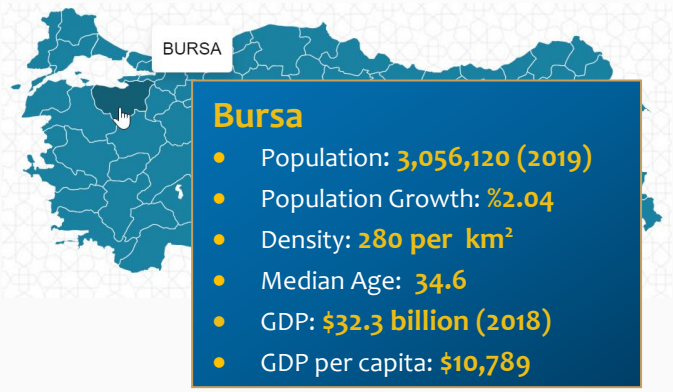
Selected Smart City Projects by İzmir Metropolitan Municipality include but not limited to:

İzmir Smart City Projects	İzmir Smart City Projects
İzmirnet – Broadband City Project	Electrified Bus Fleet
Smart Traffic System (ATS)	Mobile Apps for Transportation, Urban Services and City Guide
Wastewater Treatment Plants	Solar Panels On 10.000- M2 Roof Area
Solid Waste Disposal System	Eco-Lighting Systems in Public Spaces

Bursa

Bursa is Turkey's fourth most populous city with 3.1 million of people in 10,886-km2 areas. Bursa is an important center both for automotive and textile industries.

Bursa Metropolitan Municipality founded Smart City & Innovation Department in order to achieve an integrated strategy within the municipality and identified five smart city categories as Smart Transportation, Smart Governance, Smart Environment, Smart Society, and Smart Healthcare.



Bursa has a special smart living application named love chip for Alzheimer and mentally disabled citizens. Bursa city like some other cities started smart city solutions in mobility such as smart junction, city and traffic cameras, traffic density maps, smart car parking solutions, public transportation information systems. The city also has environmental projects such as Energy Production from Methane Gas, Energy production with sludge incineration, Tracking of Sea Brooms and Solar Power Plants. Under the environment category, the municipality promoted the use of renewable energy resources and formed a SCADA center under BUSKİ to achieve ubiquitous control, observation and real time decision making regarding these facilities (METU, 2019). City's smart card, BuKart is used for payments on metro, tram, LRT, and bus services.

Selected Smart City Projects by Bursa Metropolitan Municipality include but not limited to below:

Bursa Smart City Projects	Bursa Smart City Projects
Smart City Platform (ongoing)	Bursa Mobile Education Project (BUMEP)
Sludge Incineration and Power Generation	Tracking Chips for Alzheimer Patients
Monitoring Sea Sweepers	Smart Intersection Green Wave Control
Monitoring and Online Management Systems	Public Transport Information Systems
Mobile Apps for Tourism, 3D City Guide, Transportation, Urban services	Smart Car Parking Solutions
Energy Production with Sludge Incineration	Energy Production from Methane Gas
Solar Power Plants	Tracking of Sea Brooms

A grant has been awarded by the UK Prosperity Fund Future Cities Program to Bursa as mentioned in the section "Smart City Initiatives supported by 3rd Countries".

Konya

Konya is Turkey's largest city in terms of area and seventh largest in terms of population. It is connected to high-speed train network and therefore relatively more easily accessible to capital Ankara and İstanbul. Its population growth and GDP per capita are below the national averages of 1.39% and $9,562 respectively.

The projects and implementations within the scope of Konya smart city vision are carried out by Information Technology Department of Konya Metropolitan Municipality (KMM) and its known for its smart city initiatives in Turkey, especially in the areas of transportation and e-municipality.

Fleet management and passenger information is provided with the Smart Public Transportation System (ATUS) and dynamic traffic management, incident detection and traffic information provided with Central Traffic Operation System (METIS).

Konya

- Population: **2,232,374 (2019)**
- Population Growth: **%1.21**
- Density: **54 per km²**
- Median Age: **31.5**
- GDP: **$16.4 billion (2018)**
- GDP per capita: **$7,444**

To preserve the historic city center, Konya gave importance to use of bicycles, bicycle sharing program and the use of tram without catheters (without the use of poles and wires). Konya has 500 bicycles in its bicycle sharing program and with its 515 km bicycle road (METU, 2019).

Smart environment-based implementations of Konya include electric generation from methane gas in solid waste plant and use of smart solutions in public buildings and LEED certificated environment friendly solutions in large-scaled building complexes such as stadiums, congress centers, science centers (METU, 2019).

Selected Smart City Projects by Konya Metropolitan Municipality include but not limited to below:

Konya Smart City Projects	Konya Smart City Projects
Electricity Production from Methane Gas in Solid Waste Plant	Environmental Management Information System Center (ex.air quality monitoring, waste-noise tracking, fuel control & vehicle tracking)
Smart Public Transport System (ATUS)	EDS-Electronic Inspection System
Central Traffic Operating System	Smart Bicycle Program
Konya Science Center	E-Pattern (suitable agriculture products analysis)
Mobile Apps For City Guide, Transportation and Urban Services	Smart Junction System
Smart Waste Management	City Information System

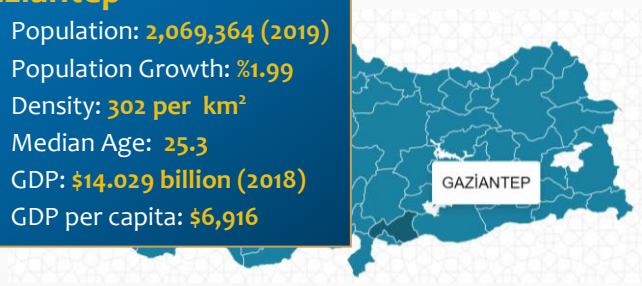
Gaziantep

Gaziantep has a population of just over 2 million and its growth rate is nearly 2% well above Turkey's average. The city is an economic center for Southeastern and Eastern Turkey. Its share of national GDP is 1.8% and is one of Turkey's major manufacturing and agriculture zones. The number of large industrial businesses established in Gaziantep comprise about 4% of Turkish industry in general.

The city has been growing into a tourism attraction center, development around the castle and accessibility improvements has added to the potential of the city. Being a border city with Syria, the city also has considerable immigrant population.

Gaziantep

- Population: **2,069,364 (2019)**
- Population Growth: **%1.99**
- Density: **302 per km²**
- Median Age: **25.3**
- GDP: **$14.029 billion (2018)**
- GDP per capita: **$6,916**



Gaziantep is one of the leading cities that has been continuously investing in smart cities. Mayor of Gaziantep Metropolitan Municipality (GMM) is the president of Union of Municipality of Turkey and has a strong vision and commitment to smart cities development.

Within the scope of smart city applications, local telecom operator Turkcell offered various technological solutions to GMM under 8 main headings. Over $11 million in 2015 was saved in GMM through smart city practices which provided efficient use of natural resources and the quality of life of the city residents have been increased. The project also achieved savings and efficiency in electricity and water consumption and excavation management. It has also been planned to establish a technological infrastructure in the Zeugma Museum and the zoo, which is visited by 2.5 million people annually (METU, 2020). Meanwhile, Gaziantep Card is used for payments on cable car, tram, LRT, and bus services.

Selected Smart City Projects by Gaziantep Metropolitan Municipality include but not limited to below:

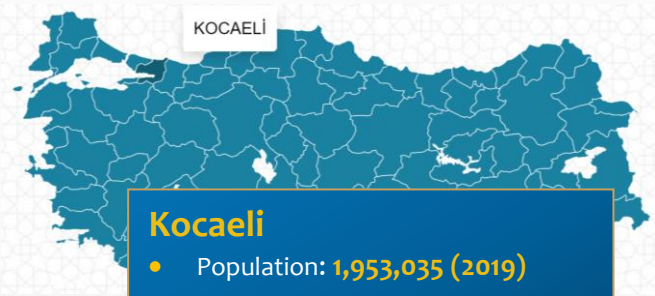
Gaziantep Smart City Projects	Gaziantep Smart City Projects
Smart Public Transport System	Water SCADA Systems
TEDES - Traffic Electronic Inspection	Smart Irrigation Systems
Traffic Signalling System	Renewable Energy Systems
Innovation Gaziantep	Smart Grid & Meters

Recently, Gaziantep Metropolitan Municipality received a technical assistance grant from USTDA for the development of a smart city roadmap as mentioned in the section "Smart City Initiatives supported by 3rd Countries".

Kocaeli

Kocaeli has a population of almost 2 million people and it is growing well above national average of 1.39%. GDP wise it ranks 5th in Turkey while on GDP per capita it ranks 2nd right after İstanbul. This is partly due to its proximity to İstanbul, as the metropolitan area of İstanbul extends to the Kocaeli-İstanbul provincial border. The size and position of the Bay of İzmit allow for extensive port facilities and Kocaeli is sometimes referred to as the industrial capital of Turkey.

As the region has been shaken by strong earthquakes in the near past, Kocaeli Metropolitan Municipality (KMM) focuses also on smart initiatives within disaster and emergency management in addition to other typical domains. In August 2018, "Kocaeli Smart City Disaster Loss Mitigation Project" is launched to establish an early warning system for all industrial establishments in the city. The smart city solution aims to provide an automatic warning to stakeholders against gas leakages, water, electricity related explosive mechanisms in factories before an earthquake.



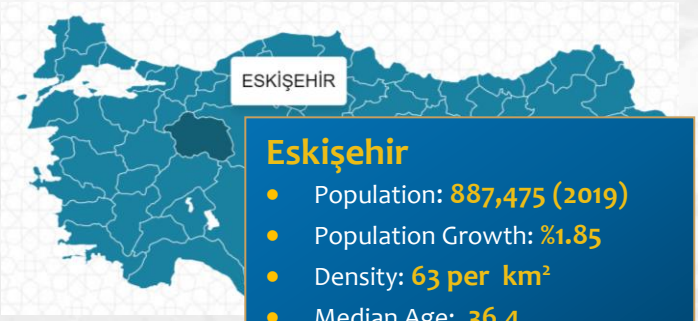
Kocaeli

- Population: **1,953,035 (2019)**
- Population Growth: **%2.42**
- Density: **538 per km²**
- Median Age: **32.3**
- GDP: **$30.032 billion (2018)**
- GDP per capita: **$15,753**

Eskişehir-Tepebaşı

Eskişehir is situated to the west of capital Ankara, connected to Turkey's high speed train network. It has a population close to 900,000 people which is growing over Turkey's average of 1.39%.

In addition to the Eskişehir Metropolitan Municipality's work, the district municipality of Tepebaşı has received a financial grant from the European Commission for -REMOURBAN-Smart City Project which was conducted between 2015-2020, for the first time as a lead city from Turkey. REMOURBAN is a 5-year long project (2015-2020) funded by the European Commission's H2020 Research and Innovation program.



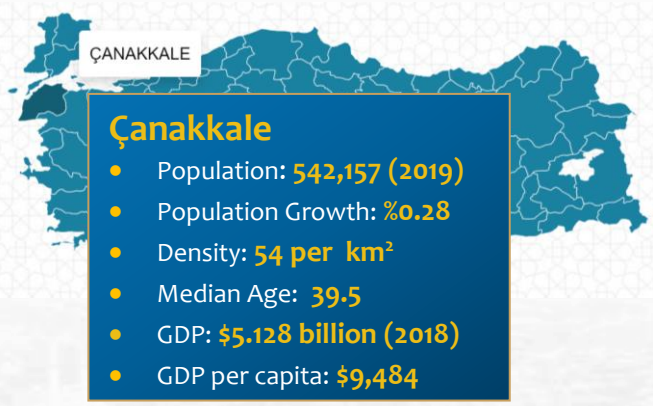
Eskişehir

- Population: **887,475 (2019)**
- Population Growth: **%1.85**
- Density: **63 per km²**
- Median Age: **36.4**
- GDP: **$8.677 billion (2018)**
- GDP per capita: **$9,959**

Çanakkale

Çanakkale is situated on the southern coast of the Dardanelles at their narrowest point. The population is over half a million and growth rate is just above zero percent, while median age is almost 40, making it the sixth oldest city in Turkey. GDP per capita is almost same as the national average. Çanakkale is among the top cities in terms of industrial energy consumption and per capita energy consumption.

Meanwhile the city is also known for its wind power installations, around 5% of the active wind power stations in Turkey are in Çanakkale, providing a total installed power of 316.5 MW (Invest in Çanakkale, 2017). Recently, SK Engineering & Construction (E&C) and Daelim Industrial won a $3 billion contract with Turkish partners to construct the world's longest suspension bridge, a 3.7 km long Çanakkale Suspension Bridge to be built over Dardanelles Strait in Turkey by 2023.



Çanakkale on my Mind Project is a smart city transformation initiative to improve the urban quality of life and to ensure a sustainable environment while providing a competitive advantage to Çanakkale on a global scale. The project was launched on 1 February 2017 under the leadership of Kale Group in collaboration with Turkish Informatics Foundation and Novusens Smart City Institute as the implementing partner (Novusens, 2017).

Çanakkale on my Mind initiative is the first smart city project in Turkey which started with the visionary leadership of a conglomerate born in that city, Kale Group, in collaboration with a prominent NGO aiming to contribute to Turkey becoming an information society (TBV) that was matched with the enthusiasm of local stakeholders.

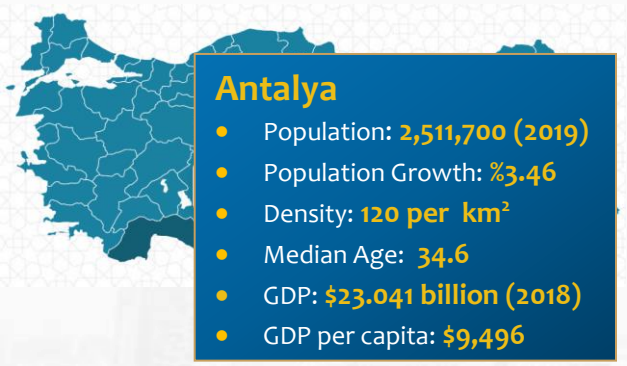
Selected Smart City Projects by Çanakkale Municipality include but not limited to below:

Çanakkale Smart City Projects	Çanakkale Smart City Projects
Smart Bus Stops	Smart Junction
Çanakkale City Card	ÇABİS Bike Sharing System
E-municipality System	City Information System
Municipality Green Building	Biological Wastewater Treatment Plant
UEDAŞ Scada System	

Çanakkale Municipality was recently the recipient of a grant for “Partnership for the Future of Smart Cities Project" within the scope of ‘Turkey and The European Union Town Twinning Grant Program’. Çanakkale Municipality has been the beneficiary of the grant, running the project in partnership with the Spanish Municipality of Tarragona, Tarragona Smart City Platform and Turkish Informatics Foundation (TBV).

Antalya

Antalya, located on Anatolia's southwest Mediterranean coast, is the 5th most populous city in Turkey and fastest growing city with a rate of 3.46%, almost 2.5 times national rate. It is Turkey's biggest international sea resort, known as Turkish Riviera. The city hosted 14.6 million tourists in 2019, 28% of Turkey's total tourists. The city's GDP is about 3% of that of Turkey's, above $23 billion. Antalya also has a major potential in agriculture production.



City of Antalya started several smart city pilot programs, such as the one with cooperation of Türk Telekom in 2015 and later with Türksat A.Ş (government owned Cable Network company). These implementations mostly revolve around automation of several urban services. The main smart city projects that are initiated by Antalya Metropolitan Municipality are: electronic control system in traffic, city information kiosks especially for tourism, panic button and remote health applications, free internet services at designated points in several districts, child and elderly tracking devices/programs and voice navigation applications. An integrated Smart City Management Platform was also established to monitor, control, and manage smart services from a center and to collect data (METU, 2019).

One of the major projects is the transformation of an urban area in Kepez Santral Neighborhood. The Municipality treats the urban transformation project as a chance to set up a smart area that would be built based on ICT solutions in the themes of energy, environment and transportation. The project has been awarded a grant by European Union Horizon 2020 program and the implementation of the project has been started in 2019 (METU, 2019).

The Antalya Smart City mobile application brings together different services such as: transport, city guide, culture and art events, city services, e-municipality under the same roof integrated with city information systems. Antalya Kart application in the field of transportation and 'ASAT MOBİL' in the field of water use and wastewater management provides information and facilitates electronic payment transactions.

Selected Smart City Projects by Antalya Municipality include but not limited to below:

Antalya Smart City Projects	Antalya Smart City Projects
Kepez Santral Neighborhood Area Urban Transformation - EU Horizon MatchUp Smart City Project (H2020 grant)	Smart City Management Platform and Automation System
Solid Waste Integrated Assessment, Recycling and Disposal Plants	City Information Screens And Kiosks
Smart Lighting	Free Public Wi-Fi Points
Smart Irrigation	Electronic Traffic Inspection System (EDS)
Chronic Patient Monitoring and Panic Button	Antalya Smart City Mobile Application

Role of Private Industry - MNCs and TELCOs Smart City Engagements

There are also smart city engagements between technology companies and municipalities. One such partnership is that of telecommunications operator **Turkcell** and **Huawei** collaborating with the city of **Ordu** after signage of an agreement in 2019. The two companies will develop technological solutions through joint collaborations in agriculture, transportation, energy, parks and the like.

The companies also agreed to launch a 'Smart City' project in **Samsun** in 2018. The project aims to provide citizens of Samsun state of the art smart city technologies in order to benefit from digital transformation in the city.

The formerly state-owned Turkish telecommunications company, **Türk Telekom** and one of its affiliated companies, **Innova**, have launched a smart city management platform where all smart applications operating in the city are managed through a single operations center. The two companies have completed two smart city pilot projects with the municipalities of **Karaman** and **Kars**. They have also moved on to the second phase of **Antalya Municipality**'s smart city infrastructure project and have similar projects in the pipeline with the municipalities of **Kırşehir** and **Mersin**.

OUTLOOK OF TOP SMART CITY INDUSTRIES

Smart city programs have been mostly led by the cities mentioned in the earlier section. After the publication of the National Smart City Strategy and Action Plan at the end of 2019, smart city transformation among municipalities have gained traction. This section analyzes smart city use cases within the context of Turkey and provides insights to each of them. Meanwhile, IDC lists the top 9 use cases for smart city technology in terms of market size (IDC, 2020b):

1. Smart grids
2. Fixed visual surveillance
3. Advanced public transit
4. Intelligent traffic management
5. Connected back office
6. Smart City platforms
7. Smart stadiums and campuses
8. Digital evidence management (in public safety)
9. Mobile video capture and recording (in public safety)

With regards to technologies frequently used in smart city applications in Turkey, mobile applications stand out the most as shown in Figure 4 (Novusens, 2016).

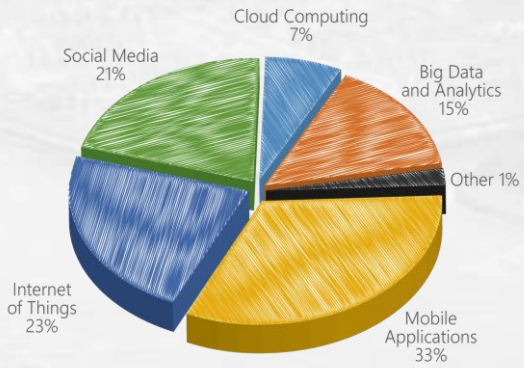


Figure 4 - Technologies used in smart city applications (Novusens, 2016)

Mobile apps are used by 70% of municipalities and by half of the directorates of water and sewage.

Internet of things mostly preferred by the metropolitan and district municipalities.

Big data analytics is mostly used by the metropolitan municipalities.

Cloud computing is mostly used by the metropolitan municipalities. 75% of cloud computing users also use GIS.

Social Media is a strong governance tool as it allows instant communication with the citizens.

Smart City Trends in Turkey

According to the national study on smart cities in Turkey, top smart city industries in which future applications were planned by the municipalities have been identified (Novusens, 2016). The top smart city industries mentioned for the near future are in transportation, energy and water respectively (Figure 5).

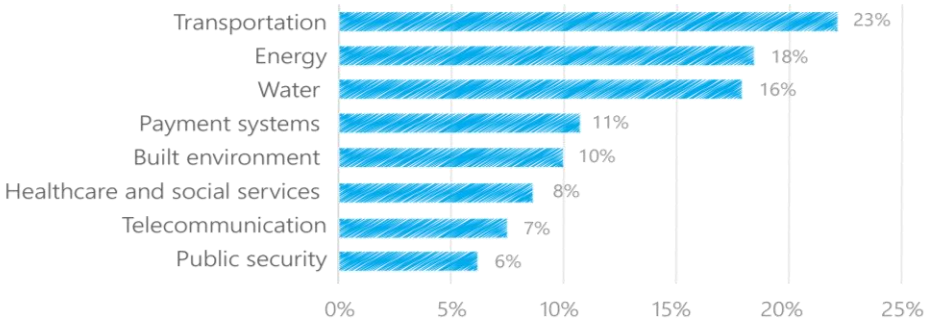


Figure 5 – Planned Smart City Applications by Municipalities (Novusens, 2016)

Two out of every three metropolitan municipalities participating in the study stated that they plan smart Mobility applications while two thirds of these are municipalities with a population of more than 500 thousand people. Half of the municipalities planning smart energy applications in the near future stated that they have plans for renewable energy projects such as solar energy.

This is also somewhat in line with global smart city trends. According to IDC, use cases related to resilient **energy and infrastructure** represented over one third of the opportunity, driven mainly by smart grids including smart **water** and smart **buildings**. Data-driven **public safety** and **intelligent transportation** represented around 18% and 14% of overall spending respectively (IDC, 2020a).

One significant difference of Turkey with developed country markets appears to be the importance of smart water systems. It should be noted that privatization in the energy sector has probably helped energy companies deal with their challenges, while municipal water and wastewater administrations (so called SKI's in Turkey) may still have more challenges to address.

Five smart city industries have been identified within the scope of this report: **Smart Mobility, Smart Energy, Smart Water, Smart Buildings** and **Smart Governance.** Under these industries, 25 use cases that are deemed important in Turkey have been listed providing information on the market and the key players. Figure 6 provides a map of typical smart city stakeholders in Turkey.

The stakeholders map in Figure 6 depicts the key players in the Turkish smart city eco-system. In this citizen centric model, Municipality and the Governor's Office are the main actors at the city level. Provincial Directorates of Ministries, Development Agencies, local Universities, NGO's and startups are other local players. The most outer ring contains possible national and international stakeholders.

The below use cases refer to some of these stakeholders as key players as appropriate.

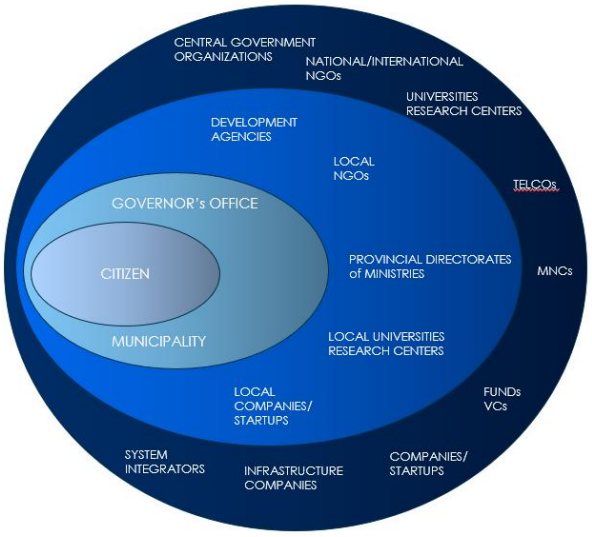


Figure 6– Smart City Stakeholder Map (Novusens)

SMART MOBILITY

Smart mobility is often cited as one of the most important smart city industry, impacting all other areas which leverages technology the most. IDC stated that 14% of the global smart city spending belongs to intelligent transportation domain (IDC, 2020a) and Turkey's smart mobility market is estimated to reach **$244 million** by 2024 at current economic conditions.

In the metropolitan municipalities where at least 750,000 people live, certain services such as public transport is provided by affiliated municipality entities. While water and sewer administrations are already established in all metropolitan municipalities, affiliated entities for public transport have been established only in Istanbul (İSBAK), Ankara (EGO), Izmir (ESHOT) and Bursa (BURULAŞ). Affiliated entities under the public law are not allowed to pursue profits although they produce and sell services. Public transport services are particularly subsidized by the municipalities.

Meanwhile, the Ministry of Transport & Infrastructure calls Turkish cities to establish smart traffic light systems, green wave systems, digital traffic signs, and solar powered bus stops in its 2013-2023 Action Plan. At the moment, many smart mobility projects are planned and realized by local municipalities. While some municipalities use their own resources, others also use local or foreign funding resources to realize such projects.

Turkey's smart mobility market estimated to reach $244 million by 2024

High rate of urbanization and the increase in travel demand challenges the transport system and increase congestion and emissions which can be reduced with more environment friendly vehicles and alternative modes of transport such as cycling and walking. Cities of İstanbul and Bursa have started preparing their Sustainable Urban Mobility Plans (SUMP) with the support of UK Prosperity Fund Future Cities Grant Program which is a strategic plan designed to satisfy the mobility needs of people and businesses in the urban environment to support a better quality of life. Meanwhile, cities of İzmir, Kocaeli, Ankara, Trabzon, Düzce and Kahramanmaraş have applied to EU IPAII program for the preparation of their SUMPs at the end of 2020.

Funding

In addition to municipal resources, governmental funding alternatives such as Regional Development Agencies, İlBank (government owned bank providing loans for local administrations in order to meet their urban needs) and Development Bank of Turkey works closely with municipalities on mobility projects.

As to international funding, finance institutions like the World Bank, European Bank for Reconstruction and Development (EBRD) and IFC (International Finance Corporation) are important funders of mobility projects. EU's Instrument for Pre-accession Assistance (IPA) is one example of structural programs used for mobility. Moreover, there are private venture capital companies like F Plus Ventures which focuses solely on smart mobility to provide funding for shared mobility companies.

Key Players

The **governance** of the mobility sector is led by Ministry of Transportation and Infrastructure. Other responsible government organizations are the General Directorate of Highways, the municipalities, provincial traffic commissions and General Directorate of Security. Other key players of smart mobility are discussed further under the use cases.

Apart from key players mentioned under the below use cases, ITU ON Lab is also an important research contributor in this area.

Regarding **local private companies**, in addition to below mentioned companies, Seyisco, Basarsoft GIS, Cardtek, Ekin Safe City Technologies, Altınay Energy Tech., Fark Labs are among important players. ASELSAN who operates on many sectors besides defense has also been focusing on smart mobility. Arcadis and Siemens are two international companies active in smart mobility in Turkey.

Top Use Cases:

Earlier studies done in Turkey provide some insight into the top smart mobility use cases. According to a study, Traffic Monitoring Systems, Smart Junctions and Smart Bus Stops are high on municipality agendas as shown in Figure 7.

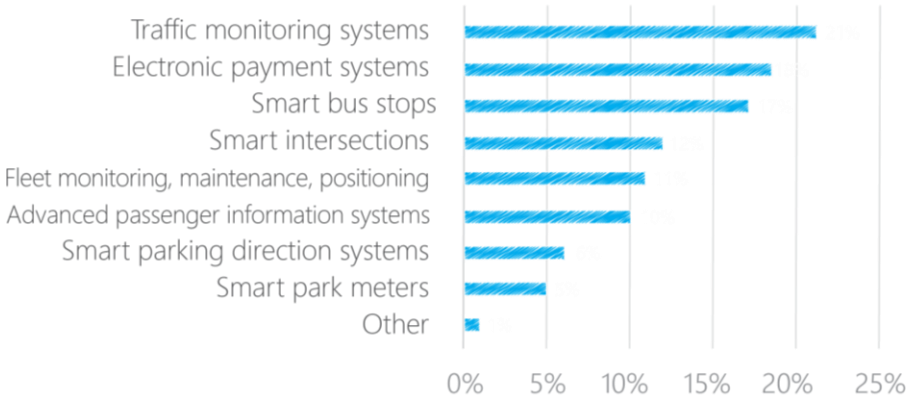


Figure 7 – Breakdown of Applications for Transportation (Novusens, 2016)

In a more recent smart mobility study done nation-wide, Intelligent Transportation Systems ranked the first among other smart mobility use cases, followed by Electrified Vehicles and Shared Mobility (Figure 8).

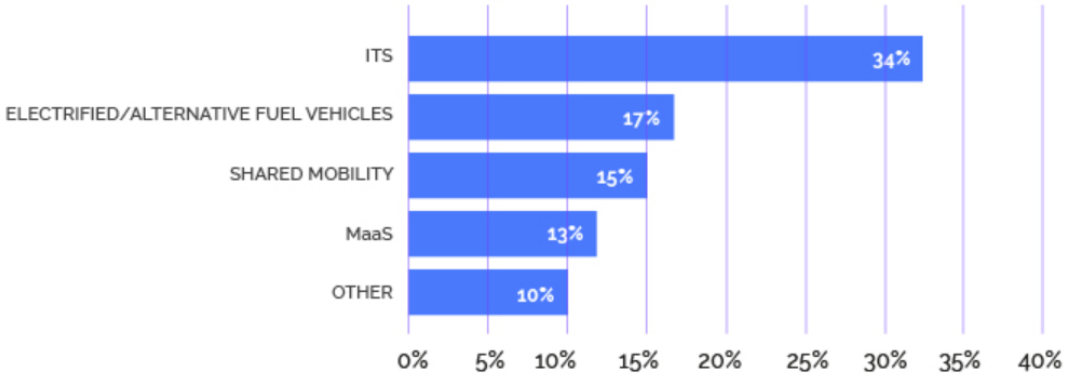


Figure 8 – Domain of Operations (Novusens, 2019)

A further breakdown of ITS in Figure 9 depicted Traffic Management Systems, Driver Safety & Support, Passenger Information Systems as the most popular ITS use cases in Turkey (Novusens, 2019).

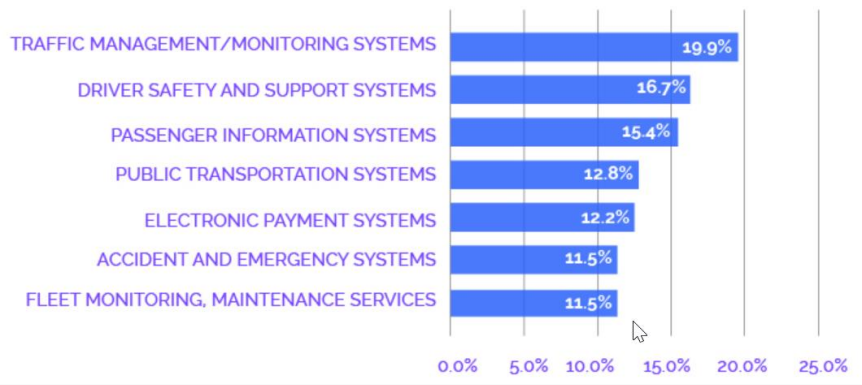
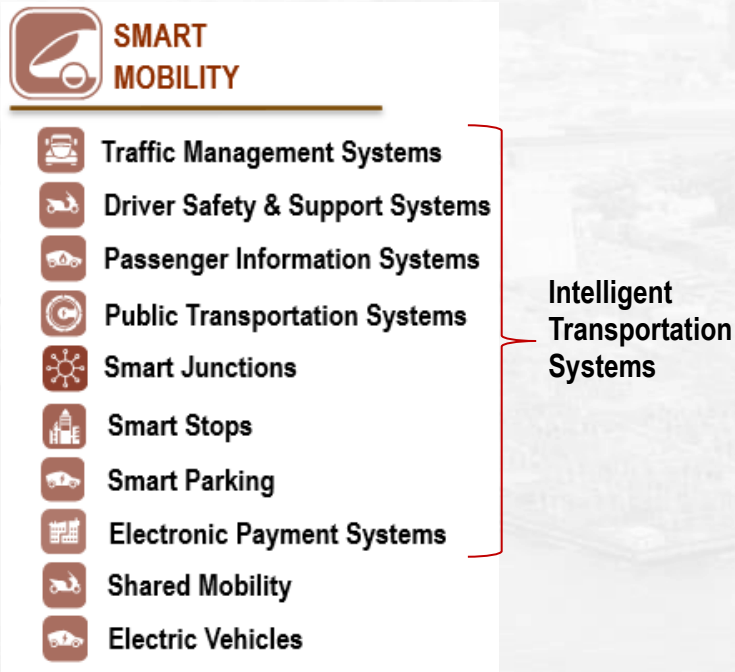


Figure 9 – Breakdown of ITS Domain (Novusens, 2019)

An analysis of existing studies combined with field data yields to below use cases under smart mobility industry in Turkey:



Intelligent Transportation Systems has been the main driver of the smart mobility industry in Turkey

Intelligent Transportation Systems

Turkey's transportation sector has been one of Turkey's fastest growing industries, tripling in value since 2002, with an average 20% annual growth rate. Turkey's geographic location combined with growing population and migration from rural areas to cities, increases the burden of traffic on municipalities, compelling them to invest in Intelligent Transportation Systems (ITS) technologies.

Since 2003, Turkey has invested $120 billion in transportation and communication industry. Highway investment ranks first with a 62.1% share in expenditures, while railway's share, which was 33% in 2013, has increased to 47% in 2020 and is expected to reach 60% in 2023 (Daily Sabah, 2020a).

As mentioned in earlier research, current top ranked use cases under smart mobility fall into the category of ITS. Up until recent years, ITS has been the main driver of the smart mobility industry in Turkey. The below 7 use cases have been categorized under ITS and will be analyzed in this section.

ITS systems are already being utilized more extensively in İstanbul, Ankara, İzmir, Bursa and to a lesser extent in other metropolitan municipalities.

Key Players:

AUSDER Turkey (ITS Turkey) is an influential NGO that drives Intelligent Transportation Systems (ITS) in Turkey. It has 42 members from government, universities, NGO's relevant universities, telecom companies and organizations from other countries including **ITS Korea**.

With regards to **knowledge institutions**, METU BILTIR Center focuses on ITS while Okan University TTIS Center focus on Electrified and Autonomous Vehicles.

Regarding local **private companies**, ISSD, Ortana, Verisun, Intetra are among key companies.

Traffic Management Systems

Traffic management centers have been established in different cities to ensure the continuity of traffic flow, to make effective use of road network capacity and to monitor traffic in real time.

İstanbul has been among the early adopters of Traffic Management Systems. Apart from Fully Adaptive Traffic Management System, the İstanbul Metropolitan Municipality's mobility subsidiary İSBAK and local

private company ISSD has established adaptive junction control systems, license plate recognition system, meteorology systems and lane management systems. The city of İzmir also has a comprehensive Fully Adaptive Traffic Management System and has been awarded for its project 'ITS İzmir' (METU, 2019b).

The so called TEDES - Electronic Traffic Inspection System and EDS – Electronic Control System are widely used in Turkey to detect red light, safety lane or speed limit violations. EDS systems are generally implemented by General Directorate of Security to spot speed violations. On the other hand, TEDES systems can also be implemented by municipalities after required approvals where a corridor is established to detect the average speed. The violation fees constitute a source of income for municipalities, such as around 30% of the fees collected. Thus, such systems are quite favorable among municipalities.

City Security Management Systems (MOBESE) utilizing images from dynamic and fixed cameras are typically integrated to Traffic Management Systems.

Driver Safety & Support Systems

With regards to Driver Safety and Support Systems, automotive manufacturers utilize cruise control, anti-lock braking systems (ABS), emergency brake assist, electronic stability control and the like in their vehicles. Telecom companies such as Turkcell provide services for emergency call (e-Call), while Türk Telekom cooperates with Honda on this service. Aselsan also offers solutions regarding e-Call.

Passenger Information Systems

In terms of passenger information systems, Variable Message / Traffic Sign systems (VMS / VTS) have been implemented in Turkish cities by companies such as Ortana and Intetra. Passenger Information Displays are typically used to show the real-time arrival of public transportation vehicles and the transportation routes. In addition to such applications, companies that work on GIS and search engines provide real time maps regarding traffic situation and navigation information. Several large metropolitan municipalities such as İstanbul and Ankara have mobile apps such as İBB Cep Trafik and ABB Trafik for providing real time traffic information to their fellow citizens.

Public Transportation Systems

Various municipalities have been using public transportation systems that monitors and provides real time information on public transportation modes, their routes, schedule, and status of the vehicles. İstanbul, Ankara, İzmir, Bursa, Konya, Bursa, Gaziantep, Kayseri are some of the cities that have established systems for providing public transportation information. KentKart is one of the local private companies working on smart cards in Turkey actively used in 25 cities across Turkey (AUSDER, 2017), while its mobile app provides information on bus arrival times.

Smart Junctions

Smart junction systems have been popular among cities in Turkey. While some big cities built a network of them, some other cities have preferred to experience them by implementing a singular junction at a certain location. Majority of the progressive Turkish cities mentioned in this document have implemented smart junctions, even though their numbers may be limited.

Smart Stops

Smart bus stops are another favorable use case for Turkish cities. Typically, smart stops in Turkey include free-wifi, charging outlets, information panels for bus arrival times, audio messaging and security camera systems. Smart Stops also provide opportunities for municipalities as information panels can also be used to generate advertisement income. In fact, local system integrator company Savronik has recently won İzmir Metropolitan Municipality subsidiary ESHOT's tender for its 5,000 bus stops and 900 buses to implement an advertising system across busses and bus stops.

Smart Parking

The need for smart parking systems is on the rise and probably the most well-known such parking system in Turkey is that of İstanbul Metropolitan Municipality's smart parking system, İSPARK. The system includes all car parks and bike sharing stations in İstanbul that are managed by the Municipality. Meanwhile, Smart Park Displays have been used in Cities like İstanbul and Kayseri for the past few years however such systems still have a lot of room for growth in the cities. On the other hand, smart parking systems have been successfully used in Turkish shopping malls, particularly in closed parking spaces.

Electronic Payment Systems

The most popular use of electronic payment systems in Turkey is for mobility purposes. A study found that 25% of the participants (largely municipalities) use smart cards and smart devices (like RFID etc.) for payments and two thirds of these were for mobility purposes (Novusens, 2016).

Meanwhile, some municipalities have also started use of contactless credit cards for public transportation purposes. Mastercard has announced that 31 cities now use contactless credit cards for payments during public transportation (Dünya Gazetesi, 2020).

As to toll collection systems on national roads, OGS is a system of radio-frequency identification (RFID) transponder type system available on toll roads and toll bridges in Turkey. On the other hand, HGS was launched in 2012 utilizing RFID but thru a tag instead of a transponder. Both OGS and HGS are still being used. Meanwhile, on sections of the recently opened highways it is possible to pay by cash or with credit card. Apart from motorways, the other state roads in Turkey are free of charge.

Shared Mobility

Shared Mobility has shown a strong growth in Turkey in the past few years and that trend is likely to accelerate even more especially considering the effect of Covid-19 pandemic on mobility needs. In Turkey, the person per car rate is 1.3, this number is an indicator of shared mobility variations to evolve. The efficiency and redundant use of personal cars can be increased up to 5 people ideally (WRI, 2018).

In the shared mobility area, bicycle operations are standing out at municipality level and also very dynamic in startup environment. In terms of product innovation, the market is immature and awaiting for international maturity to shift to mainstream understanding (WRI, 2018). Regarding different sharing options:

- **Bike sharing** systems have been implemented in over 20 cities in Turkey. Baksi and NextBike are two local companies providing solutions. İstanbul has 1500 bikes distributed over 140 stations across the city. İzmir has 720 shared bikes, followed by Kayseri's 600, Kocaeli and Konya's 500 bikes each (UCLG-MEWA, UITP 2020).
- Similar to bike sharing, **e-scooter sharing** is gaining traction in Turkey, with several municipalities taking action to bring it to their cities. Marti is local player that has expanded to 10 cities in Turkey. Meanwhile Duckt, a local startup develops and operates docking, locking and charging infrastructure solutions for micromobility.
- As to **car sharing**, Garaj Yeri, MOOV, YoYo, Electrip (Zorlu Group) are among the local players while Zipcar Turkey is also active in the sector. The reason car sharing has not enjoyed the growth of bike or e-scooter sharing is possibly because of limited of supply and lack of awareness.
- Regarding **on-demand services**, Bi-Taksi is an important local player with over 2 million users in Istanbul and Ankara. Uber has been challenged by local regulations and recently Uber Taxi has been allowed to operate in Turkey again.

Shared mobility and electrified vehicles have shown their potential in large cities and they are at the start of a growth curve especially considering the effects of the Covid-19 on the mobility industry.

Electric Vehicles

Transport is the largest user of all fuels - both fossil and renewables - in Turkey, representing more than 40% of all fuel demand, excluding the demand of the electricity sector (World Bank, 2016). Oil and its products, as well as a very small share for gas, are predominantly used to cover transport energy demand. Only 500 electric vehicles (EVs) were in use by the end of 2017 out of a total of 11.5 million vehicles in the country. Hybrid cars have fared slightly better, with more than 4,000 sold by the end of 2017 thanks to tax reduction support and the introduction of newer models (Deloitte, 2016).

Still, electric and hybrid vehicles market is growing in Turkey. According to a study, the sales of EVs and hybrid vehicles increased by 79% in 2020 compared to the first quarter of 2019 (TEHAD, 2020). Istanbul Metropolitan Municipality (IMM) aims to replace 30% of its vehicle fleet with electric and hybrid vehicles by 2023, and 50% by 2030. Meanwhile, the Istanbul Car Park Master Plan aims to accommodate more electric vehicle charging stations in car parking areas. Regarding EVs use in public transport, Istanbul MM has had some plans to introduce EV and hybrid technology in its bus fleet. In the Climate Change Action Plan, it is aimed to provide one electrically powered boat as part of Şehir Hatları fleet. (ITU IstanbulON Lab, 2020).

The Energy Market Regulatory Authority (EMRA) is also planning to release new licensing guidelines to encourage investments in charging infrastructure in the hopes of incentivizing electric vehicle sales in the coming years (Water Online, 2015).

In terms of key NGO players, TEHAD is an association for electric and hybrid vehicles, while TESİD – Electronics Industrials Association is a large NGO representing the electronics industry in Turkey.

SMART ENERGY

Cities consume about 75% of the world's natural resources and 80% of global energy supply (International Water Association, 2020) while being responsible for 70% of global CO_2 emissions. A similar situation also exists for Turkey. According to a study, after the implementation of successful practices in 30 metropolitan municipalities of Turkey, it is possible to save 20% of energy nation-wide (Deloitte & Vodafone, 2016).

Such savings combined with government's incentives and investments in renewable energy technology and production will help strengthen Turkey's energy security and reduce the current accounts deficit and ease inflationary pressures. This will also reduce carbon emissions and improve the environment (Center for American Progress, 2018). Therefore, smart energy initiatives have been high up on Turkey's agenda.

The Turkish government has put forward number of plans outlining how it intends to transform the energy sector. Many of these plans have a target date of 2023, the centenary of the Turkish Republic. Measures to improve energy efficiency form the core of these strategies, as efficiency improvements cut across all sectors that must contribute to Turkey's long-term targets. In 2018, the government released a National Energy Efficiency Action Plan (NEEAP) that outlines 55 detailed actions in all six energy sectors—industry, transport, buildings, agriculture, energy generation, and cross-cutting issues—that would reduce Turkey's primary energy demand by 14 percent by 2023 (Center for American Progress, 2018). In fulfilling this target, the government estimates the actions will attract a $10.9 billion investment over this period (Resmi Gazete, 2018).

IDC estimates that the use cases related to resilient energy and infrastructure, including Smart Water and Smart Buildings represents over one third of global smart city spending driven mainly by smart grids (IDC, 2020a). Meanwhile, in 2024 the total market for these use cases in Turkey is estimated around $576 million.

Turkey's smart energy & water infrastructure & buildings market estimated to reach $576 million by 2024

Funding

International finance institutions such as the World Bank, the Global Environment Facility, and the EU's Instrument for Pre-accession Assistance (IPA) have supported Turkey's energy efficiency implementation through loans - often on favorable financial terms - and technical assistance. The European Bank for Reconstruction and Development also has a portfolio of around €1 billion in the Turkish energy sector, mainly directed toward renewable energy capacity (Grady Wilson, 2017). Similarly, the European Investment Bank sets aside large sums of money out of its €500 million portfolio of loans across various sectors (EIB, 2020).

In terms of potential **local funding resources** for energy, İlBank (government owned bank that provides loans to local administrations in order to meet their urban needs), Development Bank of Turkey, and Private Banks such as Garanti BBVA, TEB (Turkish Economy Bank), İşBank are among the typical funders.

Key Players

The **governance** of the smart energy industry in Turkey is done by the Ministry of Energy and Natural Resources and the autonomous legal entity Energy Market Regulatory Authority (EMRA) which is

responsible for regulating and monitoring electricity, natural gas, petroleum and liquid petroleum gas (LPG) markets. Meanwhile TEDAŞ is the state-owned enterprise responsible for distribution and retail sales of electric energy in Turkey.

On the **NGO** side, ELDER - Association of Distribution System Operators is a non-governmental organization conducting its activities as an umbrella organization for 21 electricity distribution companies. Similarly, GAZBIR - Natural Gas Distribution Companies Association of Turkey, functioning as an umbrella organization for 72 natural gas distribution companies in Turkey.

With regards to **knowledge institutions**, IICEC (Sabanci University International Center for Energy and Climate) and SHURA Energy Transition Center are well known for their work in their fields.

Important **private sector players** range from large companies like EnerjiSA, Çalık Energy, Limak Energy to Reengen Energy IoT Platform. Such players are mentioned further down below for use cases as appropriate. As to **international private sector** companies operating in Turkey, GE, Siemens Energy, and Ericsson Energy can be named as main contenders.

Top Use Cases

Regarding the relative importance of various use cases within the smart energy industry, several studies have been done in Turkey, one of which is given in Figure 10:

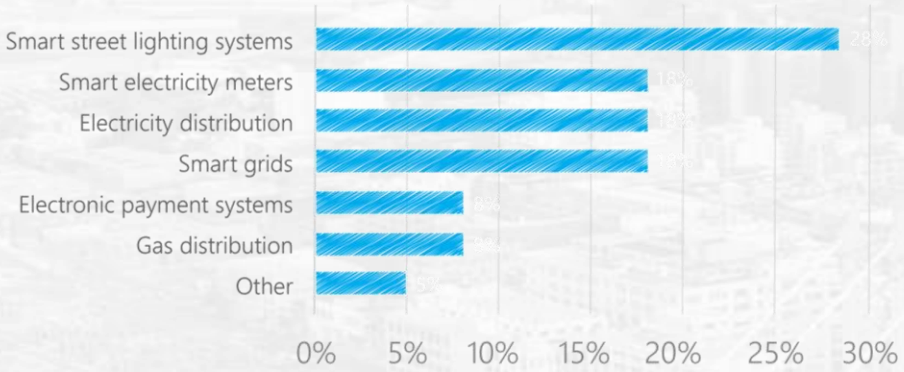
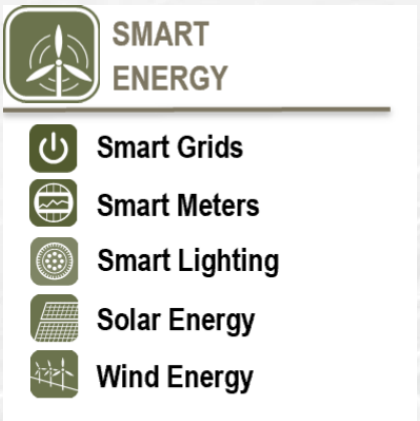


Figure 10 - Breakdown of Applications by Energy (Novusens, 2019)

Previous research findings and expert views suggest that the top smart energy use cases for Turkey can be listed as: Smart Grids, Smart Meters, Smart Lighting, Solar Energy, Wind Energy.



Smart Grids

According to IDC, smart grids is expected to be the top use case by market size globally in 2023 (IDC, 2019). Furthermore, IDC predicts that it will be the top use case by 2023 in all the 3 regions, Americas, Asia Pacific and EMEA.

Energy distribution companies have already begun to deploy smart grid systems in Turkey aiming to decrease losses, increase reliability and quality. Most have deployed SCADA and GIS systems. According to chairman of GAZBİR, the budget required to upgrade the country's 42.5 million electric meters and 14.2 million gas meters to smart grids is approximately $5 billion and $3.4 billion respectively (Anatolian Agency, 2018b).

As the majority of the electricity distribution companies' TOR (transfer of operational rights) based licenses will expire by the end 2035, the Turkey Smart Grid 2023 Vision and Strategy Roadmap sets various targets for smart grid implementation in Turkey by that time (ELDER, 2018). For example, the electricity distribution sector expects to reach 50 million subscribers by 2035, 80% of which will be able to access smart technology infrastructure. The roadmap also aims for the establishment of infrastructure for grid integration and capacity utilization management of ~15 million electric vehicles for 2035 and the necessary charging stations.

Key Players

ELDER with the strategic partnership of GAZBİR and support of EMRA have prepared the "Turkey Smart Grid 2023 Vision and Strategy Roadmap" (ELDER 2018). Therefore, ELDER and GAZBİR with their combined 93 members are considered as the major players in the smart grid industry in Turkey. On the supply side, while Huawei, Siemens, Schneider Electric are among international players, while NETAŞ and ASELSAN are among the local players.

Budget required to upgrade Turkey's 42.5 million electric meters and 14.2 million gas meters to smart grids is $5 billion and $3.4 billion

Smart Meters

EMRA (Turkey's Energy Market Regulatory Authority) and ELDER (Association of Distribution System Operators) predict that at least 80% of the country's current electricity meters will be replaced by smart meters by 2035 (Anatolian Agency, 2018).

Meanwhile energy market intelligence firm Frost & Sullivan projects smart meter installation pace to reach 3.6 million units per year by 2020 in Turkey (Smart Energy International, 2017). Factors such as lack of standardization and low consumer awareness on the benefits of smart meters has led to a slow pace of the adoption of the technology.

Furthermore, Frost & Sullivan, commented: "Regulatory support also helps set a target for the transition from mechanical to electronic meters and provides the infrastructure necessary for this migration. As Turkish authorities do not possess adequate technical expertise in smart electricity, international companies have the opportunity to present them with best practices.".

Key Players

On the solution side local companies like NETAŞ, Luna, Makel are among some of the important players for smart meters. Köhler and Elster are examples of international players in this market.

Smart Lighting

According to IDC, smart outdoor lighting is among the top 5 use cases by market size globally and is expected to be the 2nd largest use case in the EMEA region by 2023 (IDC, 2019). Furthermore, integrating smart applications with existing infrastructure used for street lighting, which accounts for almost 15% of total power consumption, will enable the optimization and monitoring of energy consumption (Deloitte, & Vodafone, 2016).

The Turkish Government intends to replace 30% of the street_lighting (there are currently 7.5 million streetlights) with smart LED lighting systems by 2023 according to National Energy Efficiency Action Plan (Emre Yılmaz et al, 2019). This change is estimated to bring a savings of $40 million, with an increase to $130 million with further LED conversion between 2023-2033.

Turkish Government intends to replace 30% the of the 7.5 million street lighting with smart LED lighting systems by 2023

Key Players

The Turkish smart lighting market is governed mainly by TEDAŞ. Members of ELDER, electricity distribution companies are responsible for establishment and operation of the lighting of boulevards, streets, underpasses, bridges, squares, intersections, walkways, pedestrian crossings and the necessary lighting and measurement systems for the general use of the public, excluding the highways and customized access-controlled highways.

Meanwhile, municipalities and provincial lighting commissions are responsible for the establishment and operation of the systems required for the illumination of public parks, gardens, walking paths, historical and archaeological sites, underpasses open to the public free of charge. Relevant organizations may transfer the operating liability of such facilities to the distribution company as well.

On the supply side local players include companies like NETAŞ, EMPA Electronics, Logiba, while international players include Signify, Itron, and Schneider Electric.

Wind Energy

By the end of 2019, renewable energy accounted for nearly 45% of all Turkey's electricity generation (Enerji Atlası, 2019). Although plans to expand wind and solar energy generation are in the pipeline, the use of natural gas for energy generation is still in the country's long-term plans. Turkey generates about 33% of its energy from natural gas.

Currently, Turkey generates around 7% of its energy from wind, reaching 21.749.838 MWh in 2019 (Enerji Atlası, 2019). Turkey has been investing considerably in wind energy, $34 billion in the past 8 years with total installed wind power reaching 8,330 MW. Turkish government aims to have 16 GW of installed capacity in solar and wind power each by 2027 (Investment Office of Turkey, 2020).

In order to create a favorable investment environment to strengthen renewables' position in the market beyond the 2020's, the government has designed various investment models such as unlicensed (small-scale), licensed (medium-scale), and YEKA (large-scale) models, which address different sorts of investors and are encouraged by lucrative incentive instruments (Investment Office of Turkey, 2020).

Key Players

Wind energy market is **governed by** the General Directorate of Renewable Energy, Turkish Electricity Transmission Company (TEİAŞ), General Directorate of Energy Affairs (EİGM), Energy Market Regulatory Authority (EMRA) and Ministry of Energy.

On the **NGO** side, Turkish Wind Energy Association (TWEA) works with most of the stakeholders of the market. Its members range from public organizations such as Ministry of Energy, TEİAŞ, TEDAŞ, to universities, from private companies to researchers.

With regards to **Knowledge Institutions**, Middle East Technical University (METU) RUZGEM Wind Energy Technologies Center and Black Sea Technical University (KTU) Energy Systems Engineering Department are among the academia working on the subject.

There are many local **private companies** working in this market, like EnerjiSA , Enercon (each winning 500 MW of wind energy tender YEKA-2 recently), Türkerler, Kalyon Energy (members of winning consortium in YEKA-1 tender amounting to $1 billion together with Siemens), Polat Energy, Demirer Energy, Güriş Energy, Borusan EnBW to name a few. Meanwhile, Siemens and General Electric are among international players.

Turkish government aims to have 16 GW of installed capacity in solar and wind power each by 2027, almost doubling the capacities.

Solar Energy

Turkey has been attempting to reduce its dependence on energy imports in order to cut back on its account deficit where energy imports account for 70% of that deficit. Therefore, Turkey has been increasing its energy production from natural resources steadily. The share of solar energy within Turkey's total energy is just above 3% with 9.620.335 MWh in 2019 (Enerji Atlası , 2019).

Turkey held the first 1,000 MW solar power YEKA tender in March 2017. A consortium of the Turkish Kalyon and Korean Hanwha Group was awarded the contract for a $1.3 billion (TL 8.93 billion) project in the central Anatolian city of Konya. The feed-in tariff at the auction was set at $6.99 per kilowatt-hour (Daily Sabah, 2020b).

Turkey will hold 74 small-scale Energy Resource Areas tenders in 36 provinces with a size ranging between 10, 15 and 20 megawatts (MW) of electricity. Turkey's solar energy power plants (GES) installed capacity has reached 6,000 MW. Also, the capacity of photovoltaic solar panels established on roofs in Turkey has surpassed 270 MW (Daily Sabah, 2020c).

There are also vast opportunities in building-integrated rooftop photovoltaics (PV) which convert sunlight into usable electricity. Nearly 500 million square meters across residential, commercial, and public buildings hold a market potential for up to 4 GW of installed capacity to be reached by 2026. The technical potential reaches 47 GW, of which half is in residential buildings (World Bank, 2018).

The challenge remains to widen access to financing for rooftop solar projects with payback periods that can easily reach up to 10 years, even in regions with frequent sunshine. To address this challenge, several options are worth consideration, including self-consumption, net metering, and net billing models. The rollout of business models such as peer-to-peer trade systems will also be important (Center for American Progress, 2018).

Key Players

On the governance side, TEDAŞ and General Directorate of Renewable Energy of Ministry of Energy are important stakeholders.

As for **NGOs**, International Solar Energy Platform Turkey (GÜNDER) and Solar Energy Investors Association (GÜYAD) are two main organizations. While GÜYAD's members include many of the local private solar energy investors, GÜNDER's members also include public institutions such as TÜBİTAK, TEDAŞ, Renewable Energy General Directorate of Ministry of Energy, TSE (Turkish Standards Institute) in addition to private companies.

Regarding **Knowledge Institutions**, Ege University Solar Energy Institute, METU GÜNAM, Özyeğin University Energy, Environment and Economy Center are among the universities with a focus on solar energy.

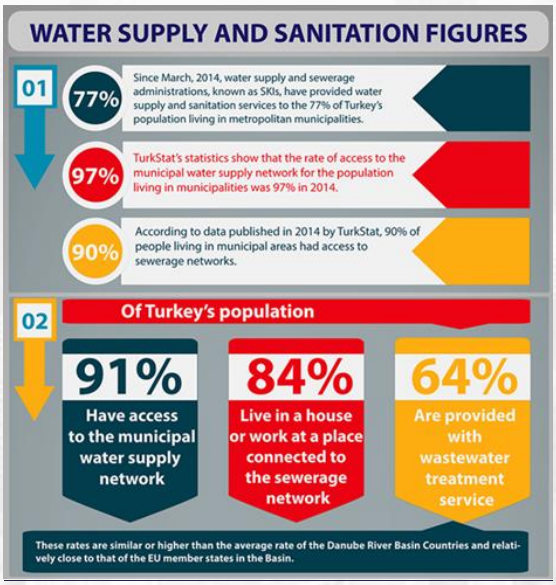
There are many local **private sector** players in the solar energy market such as Limak, Akfen, Kalyon, Borusan EnBW, Polat Energy and the like while international players also include ABB and Huawei.

SMART WATER

According to a study, artificial intelligence-supported innovation in the water sector is estimated to contribute $200 billion to global economies until 2030, about 3-3.5% of the GDP for Middle East Countries (PWC & Microsoft, 2019). The impact on Turkey's GDP can be estimated to be around $25 billion by 2030.

Contrary to the general perception, Turkey is neither a country rich in freshwater resources nor the richest country in its region. Water rich countries are those which have 10.000 cubic meters of water per capita yearly. This is well above the 1.350 cubic meters per capita in Turkey. By the year 2030, this amount will decline to 1,000 m3 per capita/year with an expected population of 100 million (MoFA, 2020).

The below infographic provides key figures for Turkey's water supply and sanitation (World Bank, 2016).



Key Players

General Directorate for Water Management (GDWM) of Ministry of Agriculture and Forestry is one of the key **government** bodies regulating this sector. General Directorate of State Hydraulic Works (DSİ) of the same Ministry is also an important stakeholder.

In Turkey, metropolitan **municipalities** are responsible for water supply and sanitation services. All the 30 metropolitan municipalities of Turkey, where 78% of Turkey's population live, have Water and Wastewater Administrations (called SKIs) as a public utility owned by the municipality but with an independent budget. Other 51 municipalities provide water and wastewater services through a municipal department. Special provincial administrations provide services in non-municipal areas (World Bank, 2016).

Regarding **NGOs**, TBB (The Union of Municipalities of Turkey) regularly organizes meetings among the General Managers of SKIs. Another umbrella organization that addresses this area is the United Cities and Local Governments Middle East and West Asia Section (UCLG-MEWA) which has a Committee on Environment. Another NGO is the Turkish Healthy Cities Association which similarly has municipalities as its members. Finally, Water Policies Association is a Turkish NGO that works on use of artificial intelligence in water systems.

Some of the local **private company** players are Luna and NETAŞ, while on the international front, Grundfos, ESRI, Hitachi and WILO are active.

As for **Knowledge Institutions**, METU Water Resources Laboratory and Dokuz Eylül University SUMER (Water Resources Management and Flood Management Control Center) are among research stakeholders.

Top Use Cases

According to a study, the top use cases of Smart Water in Turkey are Electronic Payment Systems, Smart Meters & Demand Management, Water Quality Monitoring, Leakage Detection & Preventive Maintenance, Flood Management and Wastewater Treatment (Figure 11).

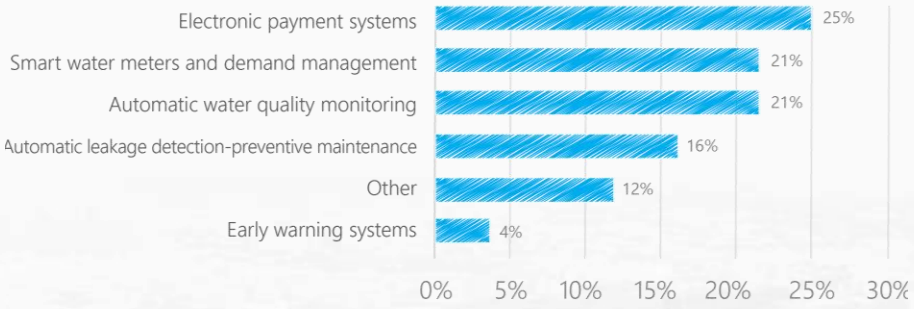


Figure 11- Breakdown of Applications for Water (Novusens, 2016)

In the light of studies already done for Turkey, in this section the following Smart Water use cases will be explored:

Electronic Payment Systems

Smart kiosks (self-service terminals) are commonly used to load credits to smart cards (pre-paid) for eventual loading to smart water meters. In Ankara, the municipality's water and sewage company ASKİ has 63 kiosks distributed across the city (ASKİ, 2020). ESKİ in Eskişehir has 48 such kiosks, while Bursa's BUSKİ has 59 such kiosks are some examples with smart kiosk payment systems. Innova and Smart-Kiosk are 2 of the local players in this sector.

Various companies also provide payment services for utility bills including water in return for a certain service fee. TamFatura and FaturaMatik are two local companies providing such services.

Leakage Detection & Prev. Main.

Municipalities are responsible for water supply in the cities, recycling, water purification, waste-sewage treatment, environmental improvement and solid waste management. In some cities up to 40% of safe, clean treated water is lost due to leakage (GSMA, 2016).

Preventing water loss is a priority for Turkish municipalities, hence leakage detection and preventive maintenance are of great importance to them. Many of the municipalities has yet to start improving their water distribution networks while some big cities have implemented SCADA systems to identify water losses and network failures. Therefore, for many of the smaller or less developed cities, upgrading of water distribution networks is a priority.

Smart Meters & Demand Mgmt

By implementing smart water metering solutions enabled by the Internet of Things (IoT), water utilities can see a holistic view of their water system that leverages smart data own by them. This is what İSKİ, a subsidiary of İstanbul Municipality which is Turkey's largest water and wastewater utility intends to do. The Istanbul Water and Sewerage Administration (ISKI) is planning to roll out smart meter coverage for all of the mega-city's 15 million inhabitants over the next decade (Global Water Intelligence, 2019). The city currently has just 5,000 smart meters installed but is planning to boost coverage as part of its grand plan to overhaul digital water services in the city.

Wastewater Treatment

In terms of water technology trends, there is a clear shift to making existing technologies that are more affordable. There is also more interest in advanced wastewater technologies (Deloitte 2016). Water treatment and reuse efforts are now spreading around the world. While water treatment simply returns much of the treated wastewater to groundwater, reuse takes the process a step further and enables reuse in agriculture, industry and even as a potable drinking source. In line with pressing need to increase water resources, the industrial water treatment and recycling market is to grow by over 50% to almost $11 billion in 2020 (Water Online 2015).

Moreover, important Turkish industries such as textile, iron/steel, chemicals, cement, food processing and automotive sectors have to make investments in wastewater treatment also.

Flood Management

In Turkey, floods rank second among natural disasters after earthquakes in terms of losses inflicted. Floods mostly happen in Black Sea, Mediterranean and West Anatolia regions during the months of spring and summer. Mostly exacerbated by deforestation, erosion and ignorant development, 10-15% of total losses are due to floods. On the average it is estimated that floods cost about $100 million a year in Turkey.

The General Directorate of Water Management under the Ministry of Agriculture and Forest is the main body responsible for Flood Management in Turkey, while metropolitan municipalities are entitled to take measures to prevent flooding in their area of responsibility.

SMART BUILDINGS

Turkey has long been a construction-driven market that is the main source of country's growth over decades while more than three quarters of Turkey's population lives in urban areas. Buildings are the largest consumer of renewable energy, making up 30%of total primary renewable energy supply (International Energy Agency, 2017). Globally, the market for smart buildings is expected to grow at a compound annual growth rate (CAGR) of 32%, reaching $43 billion by 2022 (Reuters, 2018).

Turkey's high annual urbanization rate of 2%, has led to an over 4% growth in the annual rate of new construction. The construction sector, which contributes about 6.6% to Turkey's real gross domestic product (GDP), is one of the most important driving factors shaping the Turkish economy (Kaymaz, Necmettin, 2015). Over one-third of the country's total energy consumption originates from the construction sector, including residential and non-residential sectors as shown in Figure 12.

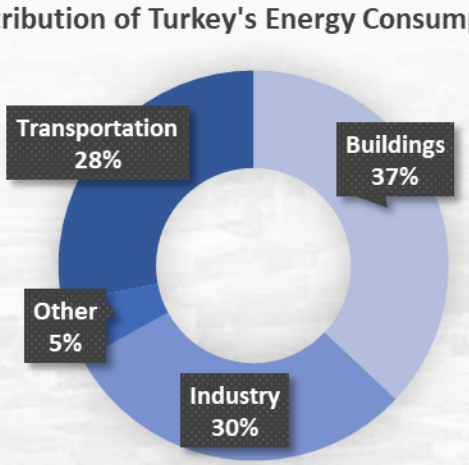


Figure 12- Distribution of Turkey's Energy Consumption (OECD/IEA 2017)

Although Turkey still lags behind EU standards, efforts are underway to align with these and other international policy benchmarks. The dramatic urban transformation of Turkey's major cities offers significant opportunities to invest in energy efficient equipment and building design (Center for American Progress, 2018).

Key Players

With regards to **governance**, two ministries play an important role in Smart Buildings: Ministry of Environment and Urbanization followed by Ministry of Energy and Natural Resources.

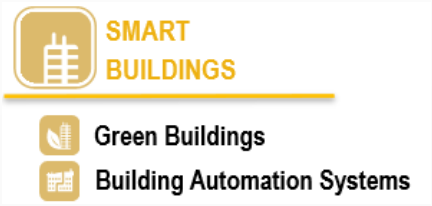
As to related **NGOs**, ÇEDBİK - Turkish Green Building Council – is active in raising awareness of energy efficiency and green building issues and has developed a green building certificate of their own, namely BEST. Energy Efficiency Association is also an important NGO active in this field with members from leading Turkish Private Sector companies.

On the related **knowledge institutions**, Ege University Solar Energy Institute, İTÜ Energy Institute, SHURA Energy Transformation Center are among the organizations working on this domain.

Regarding important **private** local players, Limak Energy, Zorlu Energy, and EnerjiSA can be cited as examples.

Top Use Cases

Although construction is the leading industry in terms of Turkey's economic growth, the concept of smart buildings is yet to evolve and has great potential. The traditional top use cases under smart buildings are building automation systems and green buildings.



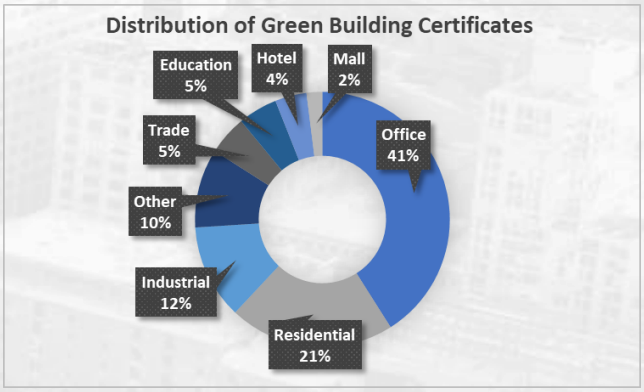
Green Buildings

As buildings account for an estimated 30% of global carbon emissions, green buildings provide one of the most economical and effective solutions to climate change with the environmental, social and economic benefits they bring (Dünya Gazetesi, 2016).

Turkey has been among the leading countries in green building certifications worldwide and expects strong growth in the industry partly due to high perceived value of such buildings. This is also evident from the data compiled from the US Green Building Council (USGBC), where Turkey ranks 6th after Canada, China, India, Brazil and Korea in terms of LEED (Leadership in Energy and Environmental Design) certified building areas as of December 31, 2018 (USA is not included in the ranking). In terms of number of projects, offices lead by 41%, followed by residential areas at 2% and industrial areas at 12% (Toki Haber ,2019).

LEED Certifications by Area and Country

Canada 46.81 million square meters
China 68.83 million square meters
India 24.81 million square meters
Brazil 16.74 million square meters
Korea 12.15 million square meters
Turkey 10.9 million square meters



In addition to the US-based LEED, a number of different building certifications are being used in Turkey like BREEAM (England), CASBEE (Japan) and DGNB (Germany). Approximately 90% of the certified buildings have LEED and the rest have BREAM, DGNB and EDGE certificates in Turkey (Toki Haber ,2019). Meanwhile, Turkish Green Building Council, Turkish Standards Institute and a group of universities established their

own green building certification known as BEST. At the moment, there are 388 LEED, followed by 40 BREAM and 23 BEST certified projects in Turkey (ÇEDBİK, 2020b).

Turkish has been among the leading countries in green building certifications worldwide, 6th after Korea.

The total area that is certified as green buildings in Turkey has more than doubled between 2016 and 2018. Istanbul ranked first among the top cities of all times by 282 certificates followed by Madrid 's 174, Stockholm's 108 and Milan's 108 (ÇEDBİK, 2020).

Building Automation Systems

Turkey's residential building stock of 2.4 billion m2 is expected to reach 4.0 billion m2 (Ecofys, 2018). The growing population and increasing urbanization constitute a major opportunity in related sectors including building automation systems as developers prefer such differentiators in their properties.

The implementation of available best energy efficiency technologies in a cost-effective manner is expected to generate an additional investment potential of 3.2 billion euros in Turkey. This is 50% higher than the current investment of €6.2 billion and increases the market value of energy efficiency technologies in Turkey to €9.4 billion (U.S. Department of Energy, 2013).

With the advancement of technologies, growing importance of climate change and energy efficiency, combined with the fact that buildings account for one third of Turkey's energy consumption, building automation systems is a promising sub-sector in Turkey.

SMART GOVERNANCE

Smart governance is generally defined as the process of utilizing technology as a tool to create a collaborative, open, participative, communication-based environment for the citizens and the government. When asked about their priorities regarding smart governance, Turkish cities responded that Online & Integrated Services for Citizens, Open Government/Data applications are on the top of their list (Figure 13).

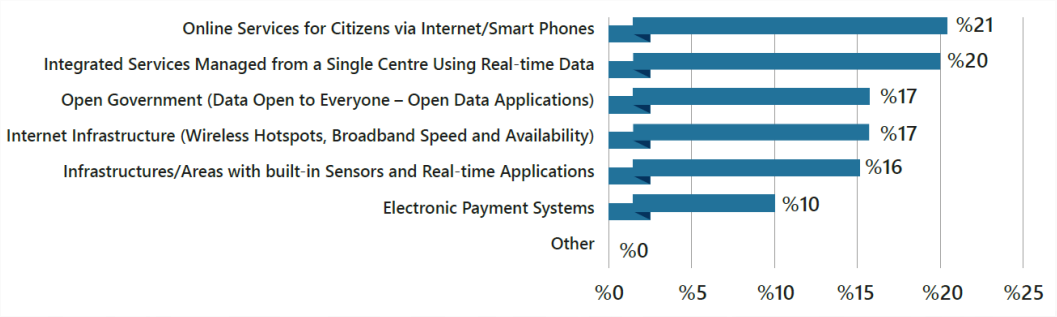


Figure 13 – Priorities for Smart Governance Applications (Novusens, 2016)

Meanwhile, the existence of municipal policy documents and strategies that refer to smart cities and divisions focused on smart cities are indicators of municipalities that are eager to manage their transformation processes with a holistic approach, in an integrated manner. In fact, according to another study, 87% of municipalities indicated that they don't yet have a smart city strategy which hinders ultimately the transformation process (MBB, 2019). The same study also found out that creation of a smart city vision and strategy is a top priority for municipalities. The National Smart City Strategy and Action Plan seems to have accelerated such efforts and the smart city transformation processes in Turkey.

Key Players:
Ministry of Environment and Urbanization and Ministry of Interior Affairs are among the key government players along with municipalities and local governor offices. Government agency TURKSAT operates the e-government portal of Turkey that has over 50 million subscribers.

On the supply side, the e-municipality systems are provided by vendors such as SAMPAŞ and NETCAD. Meanwhile, the Ministry of Interior Affairs have recently implemented an e-municipality system that is offered for free to the cities.

Top Use Cases:
The main use cases of smart governance in Turkey can be listed as below:

SMART GOVERNANCE

- Online Citizen Services
- Smart City Platform
- Public Safety and Security

Online Citizen Services

Accessing services through electronic channels and e-municipality services is the most popular application among municipalities. According to UN's E-Government Survey 2020, Turkey ranks 53rd and has moved from the high to the very high E-Government Development Index - EGDI group, whereas Republic of Korea ranks 2nd (UN, 2020). On the Local Online Services Index (LOSI), İstanbul ranks 12th among the Very High LOSI cities. Among the most frequent services provided are payments, registry search and land market value. Popular city guide applications that use GIS include 360 Virtual Tour and Cemetery Information System.

In order to facilitate the development of smart cities in Turkey, the Ministry of Environment and Urbanization (MoE) established a city information system (Kent Bilgi Sistemi) and 3D data modeling development software, both of which are offered for free to all municipalities and central government organizations. Yet many cities have to complete their GIS transformation. As to Turkey's internet infrastructure, the country has completed 4G auction in 2015 in which three incumbent operators secured licences across a range of frequencies. According to Statsgate, Turkey ranks 102th with an average download speed of 5.3 MB where Taiwan tops the list by 85MB (CeoWorld, 2020).

Key Players

NETCAD and Başarsoft are two local players particularly active in GIS related services. SAMPAŞ is another local player offering e-municipality solutions and the company has signed a collaboration agreement with Huawei in 2018 regarding smart cities.

Smart City Platform

Smart cities are also known as "system of systems." Examples of such systems are smart lighting, water/air quality monitoring, building automation, smart grids, emergency management, public safety and the like. Many municipalities and governments are working to integrate information from such systems into a unified whole to provide a holistic view of the overall performance and state of the city and its various functions using city platforms.

Open Data is essential for developing and improving smart cities. More and more infrastructures allow data to be collected, which can be of great value for the city and its citizens. In Turkey, İstanbul Metropolitan Municipality (İMM) has launched its open data portal beginning of 2020 that provides access to data collected by İMM and its subsidiary companies. Soon after İstanbul, Balıkesir Metropolitan Municipality has launched its own open data portal. This trend is likely to continue with other metropolitan municipalities in the coming years.

The global smart city platforms market size is expected to grow from $138.7 billion in 2020 to $236 billion by 2025, at a Compound Annual Growth Rate (CAGR) of 11.2% during the forecast period (Market and Markets, 2019). Although there are attempts by cities and companies to implement smart city platforms, it can still be considered to be in its beginning phase.

Key Players

Municipality demand is expected to grow for smart city platforms, starting with top metropolitan municipalities, followed by city municipalities. The Ministry of Environment and Urbanization may also help the cities in this process in terms of standardization as they did with the City Information System for

addressing GIS needs of smaller cities and towns. On the supply side, Telecom companies have been at the forefront in the Turkish smart city platform market. Turkcell started collaborating with Huawei on 5G and smart cities in Turkey, the latter also having its own platform. Turkcell also signed an agreement with Software AG to use its Cumulocity IoT platform under its Turkcell IoT Platform. Türk Telekom owned company Innova positions its own SkywaveCity platform for similar purposes. Siemens and Cisco are other strong contenders in this market.

Public Safety and Security

Public Safety and Security market has been among the top priorities of both Ministry of Interior Affairs, governor offices and municipalities over the past decade partly due to what Turkey has been through both inside and also along its borders. Among the many dimensions, particularly **video surveillance** and **biometric authentication** stand out, the latter being the more recent one.

The Public safety and security market in Turkey is projected to reach $314 million in 2024, in part due to the rising number of terror attacks and increasing investment in public safety measures for smart cities driving the market growth.

Turkey's smart governance/public safety market estimated to reach $314 million by 2024.

MOBESE (Mobile Electronic Systems Integration) video surveillance systems established by Ministry of Interior and special provincial administrations in all of the 81 provinces of Turkey has been active since 2007.

Meanwhile, Turkey being located on main earthquake fault lines makes emergency response systems a priority for government organizations and cities, as shown in Figure 14. Use of information and communication technologies effectively in dealing with such natural disasters provides collaboration opportunities for stakeholders.

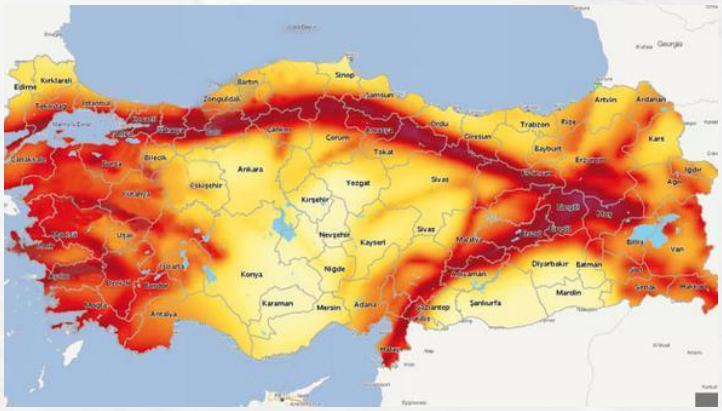


Figure 14 – Turkey's earthquake map (Hürriyet Daily News, 2017)

Covid-19

Meanwhile, Covid-19 has also emphasized the importance of **crowd management** solutions for tracking physical distancing and people densities. As a result of COVID-19, transit service and revenue pressures 40% of cities with 500,000+ residents will adopt technologies and platforms to increase private transportation solutions by 2023. Moreover, 40% of cities will use digital space planning tools, such as digital twins, to speed socioeconomic recovery from COVID-19 and ensure the safe movement of people, goods, and services by 2022 (IDC, 2020b).

Key Players

On the demand side, Ministry of Interior Affairs, governor offices and municipalities are important players. The first two are the main drivers of the market, while municipalities also own the video infrastructure for purposes of monitoring traffic, touristic sites and important places in the cities. The Disaster and Emergency Management Authority (AFAD) is a government institution working to prevent disasters and minimize disaster-related damages, plan and coordinate post-disaster response, and promote cooperation among various government agencies.

On the supply side, local players such as ASELSAN, KOÇ SİSTEM and HAVELSAN are important integrators in the market while Ekin Smart City Solutions is specialized on mobile surveillance systems.

FUNDING AND FINANCING SMART CITIES

While the smart cities movement offers exciting new opportunities for governments, their citizens, and businesses, finding the money to support such products or services can be a complex undertaking. When government officials understand the full range of options for funding, financing, and procurement; analyze the advantages of each; and choose strategies that best fit their situation, they can vastly increase the odds that their smart city initiative will succeed (Deloitte, 2018b).

Funding and financing of smart cities is one of the most important critical success factors for realizing such projects. Cities can adopt a variety of approaches to fund/finance smart city projects. Existing schemes for funding and financing smart cities can be categorized as below:

1. Government Funding
2. Institutional Financing
3. Innovative Revenue Models
4. Procurement Based Models

In **funding**, the government provides a specific amount of money for a specific purpose (e.g., to a project, usually free of charge or interest-free) with no expectation of repayment. In **financing**, someone (usually one or more financial institutions) provides an amount of capital (debt or equity) to a project with the expectation that it will be repaid with interest (Deloitte, 2018b).

An analysis of each of these Smart City Funding & Financing categories within the context of Turkey is provided below, while it should be noted that combination of these may also be used:

Government Funding

Funds are typically allocated or raised by central governing bodies or the municipalities. In order to make cities smarter, public authorities will need to integrate technology into existing infrastructure. Some examples are:

Municipal Funding

Funds are allocated by the municipalities, typically from property taxes, business licenses-taxes and the like. This has been the most widely used funding approach in Turkey up until recently as 60% of those participating in a study indicated that they depend on municipal resources for funding smart city projects, followed by İlBank and Development Bank loans (Novusens, 2016). According to same study, the sources of the Development Bank are mostly used by the district municipalities with a population between 100.000 and 500.000 people. World Bank resources are used less for financing and is mostly preferred by Directorates of Water and Sewage.

Regional Development Agencies Grant Programs

The funds are provided regionally in the form of grants through different types of programs depending on the domain. There are currently 26 Regional Development Agencies across Turkey. Most of the different types of smart city stakeholders can apply to these grants provided that they reside in the respective region. Regional Development Agencies are coordinating and facilitating local needs and priorities in the cities/regions and co-operate with the municipalities closely.

UK Prosperity Fund Future Cities Grant Program
The program explained earlier in the Smart City Initiatives Supported by Third Countries

US Trade Development Agency Next Generation Cities Grant Initiative
The program explained earlier in the Smart City Initiatives Supported by Third Countries

EU Funded Programs
European Union provides funding under several programs such as Horizon 2020, IPA, Town Twinning, Civil Society Dialogue, Eureka, Eurostars and SME Instrument. These calls can usually have a smart city or sustainability dimension. For Horizon 2020 funding received by Turkish projects has exceeded Turkey's contribution to these funds since 2014, reaching €291.6 million.

Institutional Financing

Within the scope of this report, institutional financing generally refers to non-government financial institutions such as private banks, international organizations like World Bank, EBRD, UNDP and others (Ilbank and TKYB appear under this heading for the sake of convenience). Some examples of such funding within the context of Turkey are given below:

Ilbank
Ilbank, short for İller Bankası is a state-owned development and investment bank affiliated with the Ministry of Environment and Urbanization. Main areas of expertise of Ilbank are banking and insurance, mapping, drinking water supplies and treatment, sewage collection and disposal, wastewater treatment, solid waste management, urban superstructures. The bank has been focusing on sustainable and smart cities recently.

Turkey Development and Investment Bank (TKYB)
Owned primarily by the Ministry of Treasury and Finance, TKYB provides loans for energy / resource efficiency, extension / modernization, R&D and Innovation investments among other things. It plays a major role in realizing investments in tourism, renewable energy and energy efficiency, as well as environmental investments in other industries, with the purpose of building an environmentally friendly economy. The Bank also collaborates with international financial institutions on initiatives to protect the environment and address climate change.

World Bank
The bank provides multilateral investment loans that finance goods, works such as infrastructure projects and services in support of economic development in numerous sectors like transport, water, sanitation, etc. These loans are typically for a 5- to 10-year period. In 2016 and 2018, the World Bank approved loans of $133 million and $91.5 million respectively for the Sustainable Cities I and II Projects in Turkey. The loans aim to improve the environmental and social sustainability of Turkish cities. In May 2019, an additional $560 million was approved to scale up projects in the program. The funds are assisting cities by financing investments in infrastructure needed to meet service delivery requirements in the water and wastewater systems, public transport, waste management, and energy services and the like where companies can participate in these projects as vendors to the municipalities.

European Bank for Reconstruction and Development (EBRD)

EBRD is an international financial institution owned by 69 countries, as well as the European Union and the European Investment Bank and it is unique among development banks to have an explicit environmental mandate. EBRD has invested $12.8 billion in 329 projects, while 239 are still active with a portfolio of $6.9 billion.

Innovative Revenue Models

For city governments in developing economies, the development of a business model will help them decide who will pay for the services of an infrastructure project and who will assume associated risks, below are some examples (Deloitte, 2018).

- **Indirect income generation**: from ancillary services allowed by the provider of the asset, for example, advertising revenue. In this case, revenue streams are generated by selling advertising space in the asset (Deloitte, 2018). In Turkey, İzmir Metropolitan Municipality's subsidiary ESHOT's tender for its 5,000 bus stops and 900 buses to implement an advertising system across the busses and stops is the only known example. Similarly, smart kiosks can serve a similar purpose, which are more often used for loading smart cards of water administrations in various cities. This model is in its infancy in Turkey and likely to grow in the near future.
- **User fees/charges**: In this model, users (third parties) pay directly for services, such as through road tolls. This is riskier than public sector payment due to the uncertainty of quantifying payments in advance. In certain cases, the higher risk can be offset by guarantees (Deloitte, 2018). In Turkey, some of the recent toll roads, airports, bridges built include user fees that include guarantees by the Turkish Treasury. This model of funding is already common in Turkey.

Procurement Based Models

Public-private partnership

One of the leading examples of this category is Public-private partnership (PPP) model. The government forms a contract with the private sector (typically longer term) for the provision of works or services. A PPP may involve construction of an asset, payment is actually made based on the private sector's performance and the availability of the works or services procured. (Deloitte, 2018).

In Turkey, the government has typically used Build-Operate-Transfer approach for transportation projects such as the Çanakkale 1915 Bridge that is to be completed by 2023 on with the budget of $2.8 billion.

Operating contracts

The public sector contracts (typically shorter term) with a vendor to provide goods, works, and services. These contracts may be for a range of activities, going from technical assistance to full responsibility for the operation and management of a public infrastructure asset.

Joint venture

The public and private sector would jointly deliver an asset/service in this model, utilizing the capabilities and capacity of both. The public sector often chooses such a structure to involve itself in a project even through it does not provide funding; it provides an asset that is jointly utilized through the joint venture.

MARKET DEVELOPMENT STRATEGIES

Turkey is still at a very early stage of smart city transformation which presents opportunities for many. The Turkish cities featured in this report have already started their transformation journey and have improved their smart city maturity levels. Cities such as those analyzed in the report present smart city opportunities already while other cities provide opportunities for the near future, establishing potential pipeline of smart city initiatives in Turkey for the years to come.

SWOT ANALYSIS

Figure 15 provides a SWOT analysis for smart city transformations in Turkey.

Figure 15 - SWOT analysis for smart city transformations in Turkey (Hacettepe, 2019).

The difficulty in financing and funding of smart cities is partly due to lack of innovative revenue models that is seen elsewhere in the world. As data sharing and open data are considered as life-blood of smart cities, this can be seen as an area for improvement in development of smart city projects.

Demand for sustainable environment also poses opportunities for organizations. Cities like İstanbul, Ankara and Bursa have started to address this by sustainable urban mobility program and this is likely to grow in Turkey. Meanwhile, Turkey is also following technology trends with regards to smart cities like IoT, artificial intelligence, cloud, blockchain and analytics.

The GIS infrastructure serves as a basis for many smart city applications and have been setup in many cities while it needs to be scaled to whole of Turkey. As Turkey sits on several major earthquake fault lines, the

country has initiated an urban transformation process that involves replacing old residential/governmental buildings with earthquake-resistant ones. This process is widely seen as a chance for sustainable, energy efficient, smart and green buildings and environments.

International Collaboration

According to an earlier national study, Turkish municipalities are keen to work with international companies on smart city projects, following local companies and public organizations. For the metropolitan municipalities, percentage of collaboration with international companies is more than the average (Novusens, 2016). Another research on smart mobility in Turkey indicates that Korea ranks 5th among Turkish Smart Mobility stakeholders in terms of countries being collaborated with in that domain (Novusens, 2019).

Use Cases

While there are many opportunities for companies in Turkey, it can be challenging to enter into the smart city market. One needs to know the market, its dynamics, key stakeholders before developing strategies. Therefore, this report attempts to provide basic information on smart city products/services as well as potential users such as cities, utility companies in Turkey.

Any market development strategy should begin with an understanding of the products, services or smart city use cases as explained earlier in the "Outlook of Top Smart City Industry Sectors" section. Under 5 industries (Mobility, Energy, Water, Buildings and Governance) a total of 25 smart city use cases have been identified and analyzed that are relevant to Turkey according to research findings. For each industry and associated use cases, basic information has been provided on the market and the key players.

Featured Cities

As city municipalities are among the top users of smart city technologies, the 10 cities that have been at the forefront of smart cities have been analyzed in terms of demographics, economy and smart city approaches under the section "Featured Smart City Projects in Turkey". These cities can be considered as Tier-1 cities in terms of smart city development.

Thanks to the "2020-2023 National Smart Cities Strategy and Action Plan" that was announced a year ago, many other cities have started preparing a local smart city strategy and roadmap, as it is required that all cities with a population above 50.000 must complete this by 2023. This is likely to cause an acceleration of smart city development in Turkey presenting more opportunities for many.

In the light of the information provided in earlier parts of the report, this section outlines a number of basic smart city market development strategies, from most simple to most sophisticated.

POTENTIAL STRATEGIES

Market Visits – Fairs/Trade Shows

Every such strategy needs an understanding of the costs of doing business in Turkey. Therefore, a visit to the market to gain this insight and establish relationships with potential partners is recommended. Combining such visits with local trade shows and events early in the process will increase the chances of the initial investments being successful.

For that purpose, a list of important trade shows and events in Turkey have been given in Figure 16. Due to Covid-19 pandemic, the dates and delivery formats of the events may change in time, so it is advisable to check the relevant web sites for more detailed information.

Figure 16 - Important trade shows and events in Turkey

Conference Name	Location / Date	Main Themes	Further additions
ISAF Safety Security Congress	İstanbul / March 4-7,2021	• Smart Cities • Cyber Security • Smart Governance	**Owned by**: Marmara Fuarcilik https://www.isaffuari.com/en/
3rd ITS Summit **Intelligent Transportation Systems Summit**	Ankara / March 2021	• Smart Mobility • Smart Governance • ITS	**Owned by:** ITS Turkey http://www.auszirvesi.org/en/
11th Turkey Energy Summit	İstanbul / March 29-30, 2021	• Smart Energy	**Owned by**: Marmara http://turkeyenergysummit.com/en/
Turkey Build	İstanbul / April 1-4, 2021	• Smart Buildings	**Owned by: Hyve Group** https://yapifuari.com.tr/Home/why-visit
International Conference on Water Resources and Renewable Energy Development	İstanbul / May 6-7, 2021	• Smart Water • Smart Energy	**Owned by: WASET** https://waset.org/water-resources-and-renewable-energy-development-conference-in-may-2021-in-istanbul
ICSG 2021	İstanbul/ Jun.4-5, 2021	• Smart Energy • Smart Grids • Smart Cities	**Owned by**: HHB Expo https://icsgistanbul.com/en/
Marmara Urban Forum - MARUF	İstanbul/ Oct.1-3, 2021	• Smart Cities	**Owned by**: MBB - Marmara Union of Municipalities https://marmaraurbanforum.org/
14th EIF World Energy Congress and Exhibition	Antalya/ Oct.13-15, 2021		**Owned by: EIF** http://www.worldenergy-congress.com/
TIM (Turkish Exporters Council)	İstanbul / Dec. 2021	• Innovation, Energy, Mobility	**Owned by**: TIM -Turkish Exporters Council https://www.turkiyeinovasyonhaftasi.com/
Smart Cities Congress and Fair	Ankara / TBA To Be announced	• Smart Cities • All Domains	**Owned by**: TBB - Turkish Union of Municipalities http://akillisehirler.tbb.gov.tr/
ABZ - Smart Municipalities Summit (Annual)	İstanbul/ TBA	• Smart Cities • All Domains	**Owned by**: MBB - Marmara Union of Municipalities http://www.abz.com.tr/en
Transist (Istanbul International Transport Congress and Exhibition)	İstanbul / TBA	• Smart Mobility	**Owned by**: İSBAK https://uym.ibb.gov.tr/kurumsal/haberler-ve-duyurular/transist-2018-kongre-ve-fuar%C4%B1-ger%C3%A7ekle%C5%9Fti

Representation in Turkey

Before entering the Turkish market, companies will consider their own previous business and export experience, along with strategies already adopted in similar markets. One of the most common market development strategies is to be represented by a Turkish distributor, liaison office, partner or agent. A local partner with knowledge of the market, regulatory framework, the local stakeholders may be key to success. Making use of local due-diligence services for finding the right local partner is also advisable at this stage.

Investment in Turkey

As business develops or the market is attractive enough, companies may decide to invest in Turkey by establishing subsidiaries in order to increase or establish a market share. There are various incentives provided by the Turkish Government and more information can be found at Turkey Investment Office's web site: https://www.invest.gov.tr/en/pages/home-page.aspx .

Certain MNC subsidiaries in Turkey have been using a model where funds allocated to a local implementation partner are utilized to commission smart city projects.

Meanwhile, there are generous incentives for companies that perform R&D activities in Turkey. Many MNCs such as Samsung, Huawei, Microsoft, Intel, GE, Cisco have opened Innovation Centers and/or R&D Centers. Please refer to link for more details: https://www2.deloitte.com/tr/en/pages/tax/solutions/research-development-government-incentives-overview.html# .

In a similar model, funds are allocated by a group of companies in the form of cash / in-kind contribution (equipment, human resources, content, etc.) to build up project budget. Examples of such collaborations include those by multi-national technology and telecom companies that usually start as a pilot or PoC project for scaling up later.

ALTERNATIVE APPROACHES

Foreign Trade Development Grants

A rather non-traditional method of market development that is also observed in Turkey is the one that is facilitated and supported by a governmental organization. Examples of these can be found in the "Smart City Initiatives Supported by Third Countries" section. Considering the positive perception of Korea in Turkey, such interventions could particularly prove useful in facilitating market access for Korean companies.

Such efforts can be supported by Korean institutions and universities through delivering Korean smart cities expertise to umbrella organizations such as TBB (Turkish Union of Municipalities) , MBB (Marmara Union of Municipalities) and the like.

Strategic Alliances

An alternative approach for market penetration is to form strategic alliances with important players in the market. An example of this is telecommunication companies. As Turk Telecom, the formerly state-owned, now partially owned company, has broadband fiber infrastructure in every city in Turkey, it could act as an integrator for companies while reaching out to Turkish municipalities. Turkcell, the leading mobile phone operator of Turkey, also has been investing in smart city technologies and also serves as a key systems integrator in projects. Turkey's Wealth Fund has acquired controlling stake in Turkcell in 2020.

Internationally Funded Projects

As mentioned earlier, some large projects in Turkey are also being funded by institutions such as World Bank, EBRD and the like. The funds are assisting cities to finance their investments for infrastructure such as water and wastewater systems, mobility, waste management, energy systems and other areas. Private companies can participate in such projects as vendors.

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About Novusens

Novusens is an independent private institute specialized in digital transformation and smart cities providing professional services that helps organizations deal with the challenges of today and future.

With its deep industry knowledge, technical expertise, and enterprising think tank approach, Novusens serves organizations through a range of advisory, consulting, training, research-analytics and strategy-policy development services, bringing sharp insight that pinpoints solutions, opportunities and delivers powerful results. More information about Novusens can be found at www.novusens.com.

Novusens has signed a memorandum of understanding with Korea Advanced Institute of Science and Technology (KAIST) in 2020.

This report is written by Berrin Benli and Melih Gezer, facilitated by Novusens Smart Cities Institute.