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A Study on Smartness and Sustainability of Global Cities: New York and Istanbul

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Abstract

Cities are not only places where problems such as migration, unemployment, air pollution, crime, and climate change arise, but also where many problems find solutions. After a literature review on the global city, smart sustainable city, and smart sustainable city indicators, this research examined and compared New York and Istanbul based on certain indicators. The study aims to identify the strengths, weaknesses, commonalities, and differences between cities. The performance of cities can be compared by ranking them according to different indicators. Ranking the cities can also enable them to monitor their development in different areas over the years. However, a rank-based performance comparison alone may limit a deeper view of cities' commonalities, differences, opportunities, and weaknesses. Therefore, this study examines the areas of development of New York and Istanbul from a smart sustainable city perspective, taking into account eleven different indicators including population, economy, education, energy, health, security, internet, job opportunities, transportation, water, and waste management.

Keywords: Global cities, Smart sustainable cities, New York, Istanbul

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Küresel Şehirlerin Akıllılığı ve Sürdürülebilirliği Üzerine Bir Araştırma: New York ve İstanbul

Öz

Şehirler yalnızca göç, işsizlik, hava kirliliği, suç ve iklim değişikliği gibi sorunların ortaya çıktığı yerler değil, aynı zamanda bir çok problemin çözüm bulduğu yerlerdir. Bu araştırma, küresel şehir, akıllı sürdürülebilir şehir ve akıllı sürdürülebilir şehir göstergelerine ilişkin bir literatür taramasının ardından New York ve İstanbul'u belirli göstergelere dayalı olarak incelemiş ve karşılaştırmıştır. Çalışmanın amacı şehirlerin güçlü, zayıf yanlarını, ortak yönlerini ve farklılıklarını tespit etmektir. Şehirlerin performansı, farklı göstergelere göre sıralanarak karşılaştırılabilir. Şehirlerin sıralanması, yıllar içinde farklı alanlardaki gelişimlerinin de izlenmesini sağlayabilir. Ancak, yalnızca sıralamaya dayalı bir performans karşılaştırması, şehirlerin ortak yanlarını, farklılıklarını, fırsatlarını ve zayıflıklarını daha derinlemesine görmeyi sınırlandırabilir. Bu nedenle, bu çalışma -nüfus, ekonomi, eğitim, enerji, sağlık, güvenlik, internet, iş imkanları, ulaşım, su ve atık yönetimini içeren- onbir farklı göstergeyi dikkate alarak New York ve Istanbul'un akıllı sürdürülebilir şehir perspektifinden geliştirilebilir alanlarını ortaya koymaktadır.

Anahtar Kelimeler: Küresel şehirler, Akıllı sürdürülebilir şehirler, New York, Istanbul

Introduction

Global cities' role in the economic and sustainable development of the world is significant (Wang, 2019). They contribute to greenhouse gas emissions and are frequently vulnerable to global warming and extreme weather events (Sufiyan, 2013). Moreover, global cities struggle excessively with the pathologies of a new economy such as pollution, inequality, terrorism, and the stresses of immigration if they control global power (Longworth, 2015).

Besides, cities are at the heart of answering critical global problems such as climate change (Huovila, Bosch, and Airaksinen, 2019), and assessing their performance is vital to understand their position in globalization and offers valuable information to urban planners, policymakers, and the public (Wang, 2019).

Over the years, researchers started to explore the relationship between smart cities and sustainability in different contexts (Pira, 2021). According to Huovila et al.(2019), the birth of the new concept of Smart Sustainable Cities is because of the

strong criticism of their techno-centric character and inadequate attention to environmental sustainability and cities' needs. Since the Smart City concept and sustainability share a common basis, applying Smart and sustainable initiatives will provide an effective tool to mitigate urban challenges (Pira, 2021).

This paper discusses the Smart sustainable city concept in the global city context. New York and Istanbul will be examined to explore commonalities, differences, strengths, and weaknesses considering some of the Smart sustainable city indicators. The notion of global cities and Smart sustainable cities are studied to achieve this goal. After reviewing Smart sustainable city indicators developed in the literature, a comparison of New York and Istanbul is presented.

1. Global city

The global city concept date back to Saskia Sassen's The Global City in 1991. Sassen offers a new perspective on the functional centrality of cities in the Global economy by concentrating on producer service firms' attraction to major cities that provide knowledge-rich and technology-enabled environments (Derudder, De Vos, and Witlox, 2011).

The idea of a global city is closely linked with the globalization concept, a perspective about the most favored path to local, regional, national, and international development that has been important in geography, economics, planning, politics, and governance over the years (Nelson, 2012). Sassen (2012) mentions that global cities are (1) action centers in the organization of the global economy, (2) main locations and markets for the big industries of the existing period-finance and specialized services for firms, and (3) important production sites, containing the production of innovations.

Shatkin (2007) explains that literature claims that the political, social, and spatial development of particular cities is heavily formed by their role as "command and control" centers in the world economy. Some of the analyses on developing countries' very large cities under this course have discussed the convergence of global/world cities around a model of urbanization that belongs to the West, and

especially to the United States. The author adds that this claim has demonstrated controversial, nevertheless, and an increasing chorus has debated that the global/world city concept overstresses the power of actors and institutions working at a global level, and undervalues contingency and local agency.

2. Smart Sustainable City Concepts

Sustainability is key to preserving resources for current and future generations while realizing rural, urban, or regional projects (Pira, 2021). The sustainable city development concept was created after introducing the sustainable development concept at the end of the 20th century (Janik, Ryszko, and Szafraniec, 2020), and it is growingly perceived as essential to meeting jointly agreed sustainability goals at local, regional, and global scales (Bai, Surveyer, Elmqvist, Gtazweiler, Güneralp, et al., 2016). Since there is not a single and recognized definition of "sustainable development", the sustainable city does not have one shared definition either (Janik et al.,2020). Yigitcanlar, Kamruzzaman, Foth, Sabatini-Marques, et al. (2019) explain that sustainable city development needs an interconnected triplet including society, economy, and nature that supports the formation of a socioeconomic system that is not harmful to the natural world. However, assessing the sustainability of 100 global cities using 32 different indicators showed that cities around the world were not successfully balancing the three pillars of sustainability. Moreover, many cities cope with the challenge of putting people at the core of a city's sustainability (Arcadis, 2016).

Considering Smart cities, there are still different views and misconceptions about what a smart city is (Pira, 2021; Yigitcanlar et al., 2019; Janik et al., 2020). The first use of the term 'smart city' was in the early 1990s in relation to the increased importance of new information and communications technologies and modern infrastructures within cities (Janik et al., 2020). Although sustainability has the longest history and broadest acceptance among several urban concepts, it has been

surpassed in popularity by the “smart cities” concept during the past decade (Huovila et al., 2019).

The most shared concept of a smart city is the one that uses communication and digital technologies (ICT) to improve the performance and quality of urban services, minimize costs and resource consumption, and engage more actively and effectively with its citizens (Bhattacharya, Bhattacharya, Mclellan, and Tezuka, 2020). Since cities differ in history, climate, size, demographic structure, degree of economic development, culture, and architecture, smart city solutions must consider different requirements (Milošević, Milošević, Stević, and Stanojević, 2019).

While Smart city advocates claim that smart cities will provide positive social transformation by adapting ICTs, human capital, and enhanced governance among the population, opponents mention the gaps and negative impacts that exist in their planning and implementation (Kummitha & Crutzen, 2017). Grossi & Pianezzi (2017) criticize that the Smart city utopia overlooks the necessity of political answers to public and common interests while serving the interests of big multinational ICT companies. It transfers neoliberal values and forms urban issues by turning on some features while simultaneously hiding others. Ahvenniemi, Huovila, Pinto-Seppä, and Airaksinen (2017) analyzed eight smart cities and eight urban sustainability assessment frameworks. Their observations showed a much stronger emphasis on modern technologies and "smartness" in the Smart city frameworks compared with urban sustainability frameworks. Besides, environmental indicators are insufficient in Smart city frameworks. However, they underline social and economic aspects.

A Smart sustainable city is a concept that appears to have asserted itself, and scientific literature linked to it is rapidly growing (Huovila et al., 2019; Janik et al., 2020). This concept appeared in reply to issues and challenges resulting from the acceleration of urbanization, and it became common in the mid-2010s (Janik et al., 2020). According to Yigitcanlar et al. (2019), heavy techno-centricity, practice complexity, and ad hoc conceptualization are three significant weaknesses or challenges

of smart cities in providing sustainable outcomes, and the development of Smart and sustainable cities can merely be achieved through inclusive and sustainable growth through a healthy mixture of Smart people, technologies and policies. Besides, the creation of a suitable method to assist in establishing a Sustainable and Smart city has become particularly essential to understand the ecological and social contexts of the city, its history, its primary activities, and specific features (Milošević et al., 2019).

Urban smartness and sustainability as a new emerging notion stress that both features should be studied concurrently. The emergence of Smart sustainable cities can be seen both as a) a reaction to the criticisms of such smart city solutions that are conflicting with sustainability, and b) as an effort to address the demands of the current highly digitalized cities more thoroughly than the traditional sustainability concept (Huovila et al.,2019).

A city can be made more sustainable and "smarter" in various ways (Milošević et al., 2019). Some scholars claim that smart and sustainable cities should follow a circular economy model (Yigitcanlar et al., 2019). According to Bhattacharya et al. (2020), in a developing country aiming for sustainable smart cities, apart from ICT, the habitats must be eligible for the facilities like an adequate and secure supply of water and electricity, clean and pollution-free environment, reliable transport facilities, better and affordable medical facilities, safety and security of citizens, etc. Yigitcanlar et al. (2019) add that policies that encourage the replacement of non-renewable energy and other resources, protecting open space (especially concerning biological and natural processes, assets, and services), using suitable technologies, reducing and natural assimilation of waste, and local economic and functional self-reliance are necessary to be in place for a healthy Smart and Sustainable city transformation.

3. Smart Sustainable City Indicators

Indicator models to judge the performance of Smart cities as sustainable development agents started to increase, catalyzed by the expansion of smart city solutions. Such models enable comparing cities' performance in different dimensions (Benites & Sim˜oes, 2021), target setting, monitoring, and performance assessment for city managers (Huovila et al., 2019). Selection of the indicators is very critical since it immediately influences decision-making and city management. In addition, since each city has its own context and strategic goals, it is essential to use indicators that attach to those goals (Huovila et al., 2019).

Table 1 and Table 2 present a comparison of four different smart sustainable city indicators (SSCI) suggested in the literature. Three out of four studies examined the indicators in four categories (Pira, 2021; Bhattacharya et al., 2020; Hara, Nagao, Hannoe, and Nakamura, 2016) apart from Benites & Sim˜oes (2021). All researchers suggested indicators related to the environment and economy category (Pira, 2021; Bhattacharya et al., 2020; Hara et al.,2016; Benites & Sim˜oes, 2021). Researchers proposed a society category (Hara et al.,2016) and they combined socio-cultural aspects (Pira, 2021), or divided social and cultural indicators to separate categories (Bhattacharya et al., 2020; Benites & Sim˜oes, 2021). While Pira (2021) suggested a category for Governance, Benites & Sim˜oes (2021) offered Institutional indicators. Besides, Hara et al. (2016) advised studying the Satisfaction of the citizens. At this stage, the original works of researchers were examined in further detail to see which indicators have been repeated by different studies and which have been considered at greater length. Later, New York and Istanbul were reviewed based on the indicators having a major length. As a result of the analysis, New York and Istanbul decided to be examined in terms of Population, Education, Economy, Energy, Health, Internet, Job opportunities, Safety, Transportation, Water, and Waste.

Table 1: *Smart Sustainable City Indicators (Part 1)*

Smart sustainable city indicators Pira (2021)		**Breakdown of sustainability dashboard indices Benites& Sim˜oes (2021)**	
Category	**Indicator**	**Category**	**Sub-indices and derived indicators**
Socio-cultural	Healthcare delivery, Quality drinking water, Individuals' health monitoring, Quality food, Education funding, Free education, Low crime rate, Population density, Population growth rate, Investment in culture, Civic engagement	Social	Poverty index, gender equality, nutritional regime, health, mortality, sanitation conditions, drinking water, educational level, literacy, housing, violence, and population
		Cultural	Heritage, cultural identity and diversity, tourism, recreation, art, and aesthetics/design
Economic	Affordable housing, Start-ups, International collaboration, Low poverty rate, Job opportunities	Economic	Economic performance, trading, financial status, material consumption, energy consumption, waste generation and management, and transport.
Environmental	Green spaces, Air quality, Low pollution, Energy use, Waste generation, Sustainability-certified buildings	Ecological/ Environmental	Climate change, ozone layer depletion, air quality, agriculture, forests, desertification, urbanization, coastal zone, fishing, water volume, water quality, ecosystem, and species.
Governance	E-governance, Real-time data monitoring, Internet and Wi-Fi coverage, Disaster preparedness, Public transport, Clean-energy transport	Institutional	Ethics and trust reinforcement, sustainable development strategic implementation, international cooperation, access to information, communication infrastructure, science and technology, natural disasters - preparedness and response - and sustainable development monitoring.

Table 2: *Smart Sustainable City Indicators (Part 2)*

Smart Sustainable City Development Index Bhattacharya et al.(2020)		**Key Performance Indicators for a Smart Sustainable City Hara et al.(2016)**		
Category	**Indicators**	**1st Layer**	**2nd Layer**	**3rd Layer**
Social Dimension	Health, Education , Transportation , ICT , Demography	Society	Safety	Accident, Natural disaster, Crime, Information Security
Culture & Lifestyle Dimension	Recreational facilities, Safety		Health	Health management, Prevention of illness, Medical treatment, Stress
			Comfort	Diverse opportunities, Barrier free, Simplicity, Ubiquitous
Economic Dimension	Income and Employment	Economy	Economy	Cost performance
Environment Dimension	Energy, Water, Land, Biodiversity, Sanitation & Waste Management, Pollution	Environment	Environment	Environment/natural resource, Energy
		Satisfaction	Satisfaction	Citizens' degree of satisfaction

4. Comparison of New York and Istanbul

New York has been a crowded city all the time (Shah, Kothari, and Doshi, 2019). It is one of the centers of social diversity, finance, and growth. Global problems are administered through a capitalist approach that is the tertiary services business sector and market-oriented management (Kubina, Šulyová & Vodák, 2021). Cohen who reviews the parameters of sustainability and innovation, ranked New York in the 3rd place in the Top 10 Smart Cities around the world. New York's score was higher than the majority of other cities in the ranking in all of the categories besides life quality (Ercoşkun, 2016). There are numerous plans and programs to transform New York City (NYC) into a smart city (Shah,Kothari & Doshi, 2019). For instance, as the city's smart city strategic plan, OneNYC supports a vision of a strong and equitable city. In addition, a "Smart city" is not seen as a goal but as a path to accomplish its goals in New York instead (ARUP, 2017). Besides, New York's Vision 2030 is built on five foundational pillars including i) digitalization, ii) environmental, social, and governance, iii) diversity, equity and inclusion, iv) resilience, and v) resource alignment.

Istanbul has the 23rd largest urban area in the world (Ercoşkun, 2016) and it has become internationally important by moving national boundaries due to its population, strategic location, and contribution to the domestic economy (Eren&Şimşek, 2016). Istanbul, as a value-gaining and developing city is getting increasingly higher in the smart city index. The city's actions regarding smart city applications started before 2015. The Smart Cities Special Commission was founded in the Istanbul Metropolitan Municipality in April 2015 to achieve the 2023 Focus City targets (Çelikyay, 2017). Moreover, Istanbul's Smarter City Initiative is giving rise to new/improved infrastructure, human capacity development, and better safety and security, in addition to positive results on education, health services, transportation, power, and emergency/crisis management (Bower, 2018).

Istanbul may not be enlarging at the excessive speed of Shanghai or Mumbai, or be under the increasing social inequality and violence of Mexico City, São Paulo, or Johannesburg. However, it tackles many of the same issues in New York, Berlin, and London such as economic stability, social coherence, and climate change (Burdett, 2009). A comparison of different mega-cities by Batur & Koç (2017) indicated that while the population of Istanbul is around 1.68 times more than the population of New York, the total metro network (km) is nearly 2.65 times more in New York. Besides, car ownership per 1000 residents in New York is around 1.41 times more than car ownership in Istanbul. However, the total road network (km) of New York is 1.73 times more than the amount in Istanbul, and the congestion index of Istanbul is higher than the congestion index of New York.

The Global Power City Index measures six functions including Economy, Livability, Cultural Interaction, Environment, Research and Development, and Accessibility, and ranks the cities of the world based on their "magnetism" (The Mori Memorial Foundation, 2022). While New York achieved 2nd place, Istanbul achieved 32nd place in the ranking list of 2021. Although New York's position did not fluctuate between 2013 to 2022, Istanbul's position seemed very fragile. Istanbul could not maintain the achieved position of 2014 and 2016 (21st) in 2022. Figure 1 indicates the comparison of the place of the cities in different categories. Social cohesion, international profile, and environment are the categories where Istanbul and New York seem to perform close to each other in terms of ranking. In terms of economy, human capital, technology, urban planning, and governance, there seems to be a significant difference in cities' performance.

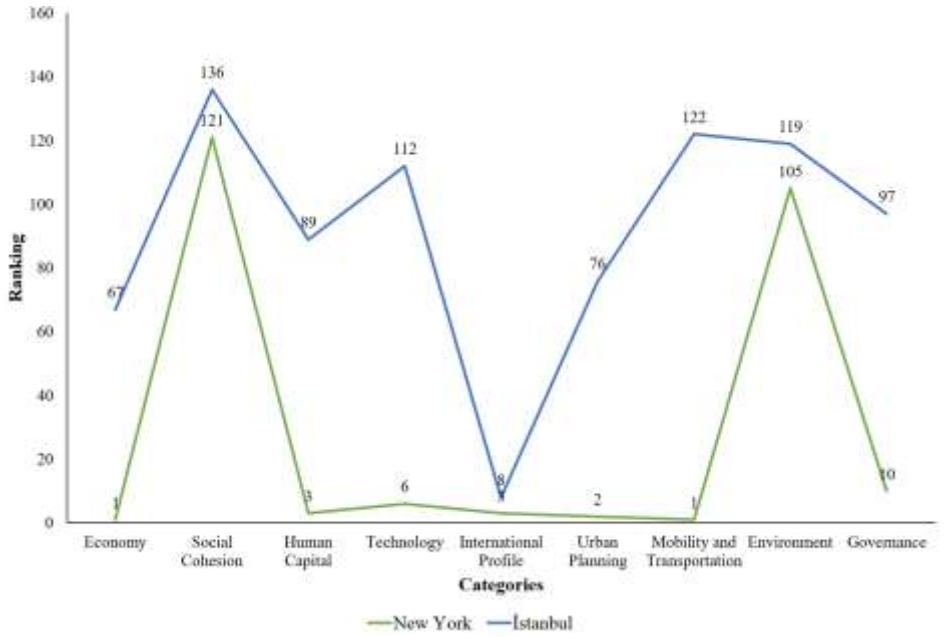

Figure 1. The Global Power City Index Comparison of New York and Istanbul

Arcadis Sustainable Cities Index ranks cities by focusing on the priority of Planet, People, and Profit respectively. Planet pillar contains indicators related to environmental sustainability that are not limited to air pollution, bicycle infrastructure, energy consumption and renewable energy share, green spaces, sustainable transport incentives, and waste management. While New York ranked in 36th place, Istanbul ranked in 55th place considering Planet pillar (Figure 2). The people pillar considers indicators to open the highest potential for the citizens. Some of the indicators are crime, education, health, income inequality, and Wi-Fi availability. Regarding the People pillar, New York ranked in the 42nd place and Istanbul ranked in the 74th place. The profit pillar includes more economic measurement indicators such as employment, economic development, affordability, and ease of doing business. Given the profit pillar, New York was in 14th place while Istanbul was in the 79th place. Especially, the performance of the cities differs regarding the Profit pillar.

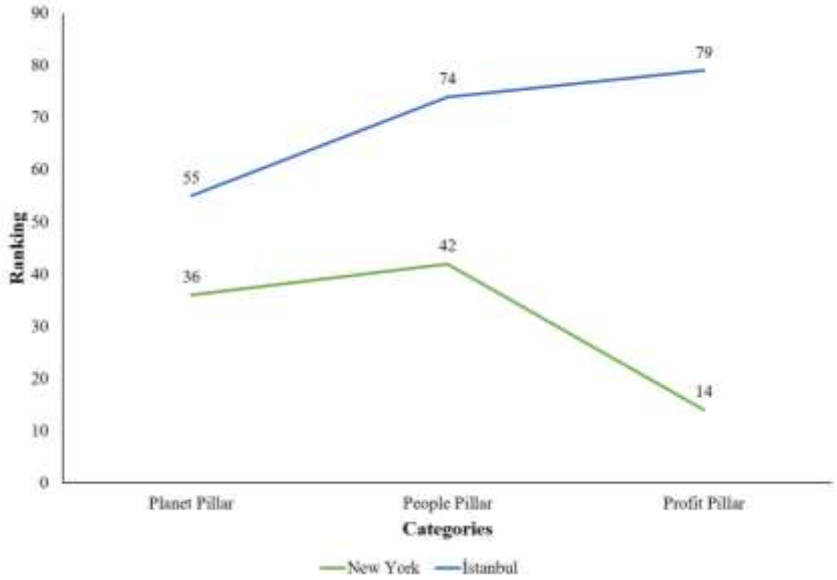

Figure 2. Arcadis Sustainable Cities Index Comparison of New York and Istanbul

4.1 Population indicator

The massive populations and high levels of consumption that portray the cities in the US and Europe, present remarkably destructive challenges to achieving three main pillars of sustainability (Mcdonogh, Isenhour & Checker, 2011).

The estimated population of New York City was 8,622,698, as of April 1, 2020 (NYC, 2023a). 37.2 percent of the city's population is made up of immigrants who constitute 44.2 percent of the labor force (NYC, 2023b). New York underlines the significance of assertive and flexible management, which should predict cultural conflicts in diversity management. Multicultural management plans are coordinated with smart city development programs, such as PlaNYC 2030 in the city (Šulyová & Vodák, 2020).

Istanbul with an estimated population of 15,907,951 in 2022 (TUIK, 2023) is the most populated city in Turkey (Erçetin, 2014) and it is the economic, financial, and industrial center of modern Turkey (Batur&Koç, 2017). Moreover, it is one of

the most rapidly growing cities in Europe (Van Leeuwen&Sjerps, 2015). The annual population growth is 2.8 percent which is nearly twice the overall rate of the whole of Turkey, due to a large in-migration (Van Leeuwen&Sjerps, 2015). Furthermore, there are over 1 million foreigners including refugees in Istanbul (Hurriyet Daily News, 2018).

4.2 Economy indicator

Cities that coordinate the integration of their national economies into the global economy, tend to obtain global/world city status and usually are found at the heart of large "global city regions" (Shatkin, 2007 cited from Scott).

New York is one of such centers, together with London and Tokyo that control financial and commercial operations around the whole world (Portes & Martínez, 2019 cited from Sassen). One of the main goals of New York's smart city strategy is economic development. It is believed that providing technology to the city can encourage the city as a platform, attract businesses to the city and grow the local economy (ARUP, 2017). However, income inequality has exceeded the national average in New York and 45% of New Yorkers live in or near poverty (ARUP, 2017). Taş (2022) suggests that income equality will be reinforced by human capital, an increased trade volume, spending more on research and development, and mitigating unemployment. According to Global EDGE (2020), New York was the 3rd largest exporter and 4th largest importer in the US in 2020. Total imports were 2.34 times more than total exports, creating a negative trade balance. While Switzerland, China, and Canada are the top three import countries, precious stones & metals, electrical machinery, and industrial machinery are the top 3 import goods.

Istanbul contributes 22 percent of Turkey's GDP, with 17.8 percent of the national population (Burdett, 2009). However, Istanbul is the most unequal city in terms of income in Turkey (TUIK, 2022a). Istanbul was the top exporter and the importer in the country in February 2023. Imports were 1.79 times more than exports, causing a negative trade balance. Besides, while Turkey imported mostly from

Russia, Switzerland, and China in February 2023, the top 3 import goods were cars, tractors, trucks & parts thereof, electrical machinery and electronics, and precious stones, metals & pearls (OEC, 2023). Istanbul demonstrates considerable progress in past years. However, its resources still are not satisfactory for international competition concerning finance (Eren & Şimşek, 2016). Besides, Istanbul Regional Plan for 2014-2023 aims to make Istanbul a strategic actor in the global economy while maintaining its unique tenets, spreading the transfer of knowledge and technology among others, and enhancing standards of living for citizens (Bower, 2018).

4.3 Education indicator

Akçura & Avci (2014) specified the essential factors that help create global cities and found that country-level features like education or humans play strong parts in global cities.

There were 1859 schools and 1,058,888 students in 2021-22 in New York. 71.9 percent of these students were in financial difficulties (New York City Department of Education, 2023). Funding for education has grown by $2.9 billion over the last three years and the New NY Education Reform Commission has been created to assure the efficient use of the funds in 2012. The commission consists of a group of nationally acknowledged education, business, and community leaders, responsible for giving guidance for future reforms in education (New York Smart Schools Commission Report, 2014). Percent of people that are high school graduates or higher is 83.2% in New York, while the percentage is 39.6% for people holding Bachelor's degree or higher (U.S.Census Bureau, 2022).

There were 7437 schools, of which 3790 were private and 3,175,285 students in 2019 in Istanbul (T.C.Istanbul Valiliği, 2019). Additionally, there are 51 universities with 400.000 students. The average age is 30 and its young population is a notable advantage for Istanbul (Bulu, Önder, and Aksakalli, 2014). Turkey's first smart city strategy and action plan is the 2020-2023 National Smart Cities Strategy and Action Plan. The document states that sustainable development of smart cities will be possible when local governments develop a vision for the city of today

and the future. It is mentioned that an improvement and adaptation to the smart city requirements are aimed not only at preschool, primary, secondary, and high school levels but also at undergraduate and postgraduate education (Gülseçen, 2020).

4.4 Energy indicator

Energy is one of the fundamental resources of a city. Rising energy prices lead cities to use energy more effectively and efficiently (Bulu et al., 2014).

The Accelerated Conservation and Efficiency Program offers funding for city agencies to apply energy efficiency developments in New York City (Csukás & Szabó, 2021). Razmjoo, Gandomi, Pazhoohesh, Mirjalili & Rezaei (2022) presented the most important policies and strategies of eight cities. According to this study, New York has powerful policies and strategies in the sector such as the wide application of renewable energy, green roof development, and the use of the energy-efficient streetlight system. Furthermore, in the building sector, there are important policies and strategies on smart infrastructure, improved infrastructure, and green buildings. Besides, 70 percent of electricity in the city was codified to come from renewable energy sources like wind and solar by 2030 (New York State, 2023). However, Doğan, Williams & Williams (2023) found that renewable energy investments were reduced when economic policy uncertainty increased in G-7 countries. Urban Green Council provides important insights for a sustainable future in New York. According to the Council (2020), New York is among the earliest American cities on collecting data about the energy and water consumption in large buildings. Nearly 22.6 percent of total emission reduction was achieved in around 3200 regularly benchmarked properties during the last 10 years. Although New York is home to 3.7 percent of the country's population, it produces only 1 percent of its overall greenhouse gases (Burdett, 2009). However, the speed of building emissions reduction has lately slowed. New York aims to reduce greenhouse gas emissions by 80 percent from 2005 levels by 2050. Therefore, prolongation of this trend will cause the city to miss its goal (Urban Green Council, 2020).

Eren & Şimşek (2016) state that Istanbul can be in a better position in global cities indices if significant improvement and structural reforms are performed regarding energy consumption, environment, constructing green energy-saving buildings, green action planning, environmental management, and public participation. Dincer, Javani, and Karayel (2022) add that because of the small area and substantial population, heavy traffic, and, numerous industrial areas, a shift from relying on fossil fuels to renewable energy-based systems is necessary. There are various renewable energy resources around the city, such as wind, solar, geothermal, hydroelectric, underwater current, and biomass energy. Moreover, Eren & Şimşek (2016) explain that buildings in the city generally do not display features of green construction. Istanbul is in slow, but balanced progress in three main fields (social, natural, and economic), and an average quality has been obtained in environmental problems (energy, air, water, CO_2, environmental management, waste, etc.) compared to other global cities. Dincer et al. (2022) studied hydrogen production from renewable energy sources, such as solar, wind, biomass, geothermal, and underwater current in Istanbul. The results gave the districts with the highest potential for green hydrogen. Gülseçen, Gezer, Çelik, and Koçoğlu (2021) present some of the smart green projects of Istanbul related to energy. Sea Solar Power Plant Project aims that 55% of the energy consumed in Istanbul until 2033 come from renewables. In addition, the Solar G-Charge project uses solar energy at parking stations for a more energy-efficient and sustainable living.

4.5 Health indicator

Cities worldwide are making efforts to improve the quality of their citizens' lives, using strategies like improvements in access to healthcare services and safety, and investments in resilient infrastructure to fight climate change (A.T. Kearney, 2016). According to Moreno, Allam, Chabaud, Gall & Pratlong (2021), six necessary functions to maintain a decent urban life include healthcare, education, working, commerce, living, and entertainment.

New York had 161 hospitals in 2021, of which 138 were not-profit (Statista, 2023). There were at least 2,000 deaths, around 1,400 admissions for health conditions and lung to the hospitals, and 3,750 admissions for asthma to the emergency department every year between 2015 and 2017 in the city. Moreover, higher baseline rates of various health conditions, involving those connected with air pollution are seen in high-poverty neighbourhoods (NYC, 2022). New Yorkers confront many obstacles to getting quality and affordable health care. Uninsured adult New Yorkers are around 1 million, another 500,000 don't have consistent coverage and further need a regular provider. Each of them positions New Yorkers at risk for not getting regular, preventive services and needed care (New York City Department of Health and Mental Hygiene, 2007).

In comparison to the previous year, there was a 41.6% increase in total health expenditure in 2021 in Turkey (TUIK, 2022b). There are 234 hospitals and 46,960 beds in Istanbul. Population per emergency care ambulance was highest with 29,066 people in 2021 in Istanbul. While the number of hospital beds per 10000 population was 24,3 in 2002, it increased to 29,6 in 2021. In addition, the bed occupation rate reduced by 15,4% in 2021 compared to 2002 (The Ministry of Health, 2021). Paköz (2014) examined the spatial accessibility of health facilities and the related health facility location problem in Istanbul. The results showed that there were important differences between districts in terms of spatial accessibility and proficiency rates which make some districts disadvantageous.

4.6 Safety indicator

According to Bower (2018), smart city technologies can deliver some enhanced public safety outcomes such as allowing better distribution of resources, reducing response times, and reducing crime levels through more prevention, and so on (cited from Smart Cities Council).

The Mayor's Office of Data Analytics (MODA) in New York City collects and examines data to handle public safety, and quality of life issues better. As an

example, the city's response was handled through analytics during Hurricane Sandy which dislocated one-eighth of NYC's populace. MODA integrated residents' responses to surveys to distribute the resources of disaster response to the most susceptible inhabitants (ARUP, 2017). Around 12% of index crimes occur outdoors and during night-time hours on New York City's public housing developments (Chalfin, Hansen, Lerner, and Parker, 2022). Chalfin et al. (2022) studied the impact of temporary street lights on outdoor index crimes. The results indicated that night-time outdoor index crimes declined substantially in communities with more lighting. Ceccato, Kahn, Herrmann & Östlund (2022) compared the potential impact of pandemic restrictions on spatial and temporal patterns of crime in New York City, São Paulo, and Stockholm. The results showed that crime levels were considerably lower (except for murder) in all cities in the first months of 2020. However, crime started to rise again after a few months. The authors stated that in general, the pandemic could not entirely maintain a reduction of crime at an aggregate level for more than a couple of months which can demonstrate the weak capacity of law enforcement to limit crime levels.

Implementation of the Istanbul Smarter City Project fosters Istanbul's government data safety and security. In addition, it improves the physical safety and security of the public (Bower, 2018). Ergun & Yirmibeşoğlu (2007) studied the crime rates in districts of Istanbul. Their study included theft (from homes businesses, and cars), homicide, attempted homicide, assault, aggravated assault, and pick-pocketing/snatching in their calculations in 2003. While higher crime rates were seen in the districts that were closer to the center and were older, lower crime rates were seen in new districts that were established as a consequence of migration from rural areas of Istanbul. Bilen, Aşkın, and Büyüklü (2013) mapped the citizens' crime fear using GIS in Istanbul. A survey of 1,837 people showed that individuals felt safe during the daytime in homes and neighborhoods. In addition, they never felt unsafe at night. However, the results are contrary to the general view of Istanbul being unsafe.

4.7 Internet indicator

Internet use and telecommunication technologies substantially modify how city authorities plan, implement their tasks and evaluate their successes (Akçura & Avci, 2014). Besides, if people have easy access to government information and services, they will engage more fully in government (Bower, 2018).

Households with a computer and with a broadband Internet subscription are 92% and 86.2% in New York (U.S. Census Bureau, 2023). To improve citizens' quality of life and government services, New York undergoes a transformation via multiple programs such as "New York City Connected Communities" and "LinkNYC". While computer centers were developed by the government in places with highly dense poverty rates in the first program, developing a free ultra-high-speed WiFi network was the purpose of the second one (Lai, Jia, Dong, Wang, Tao, et al., 2020).

According to TUIK (2021b), Istanbul is the city with the highest proportion of households with Internet access (97.1%) in Turkey. In addition, it is the leading city in the total number of mobile telephone and broadband subscriptions, and the length of fiber cable in Turkey (Ercoşkun, 2016). Although Istanbul has covered ground in areas of research sufficiency, information, and communication technology, research and development, and housing the head offices of global firms, more improvements in these topics are needed (Eren & Şimşek, 2016). Recently, governmental agencies in Istanbul started to use information technology systems effectively to control and monitor Istanbul's problems related to energy, infrastructure, transportation, and resources (Bulu et al.,2014). Gülseçen et al. (2021) mentioned some of the smart green projects developed in Istanbul. For instance, the IBB WIFI project is a free internet project providing citizens a daily 1GB Quota with 2Mps speed. Besides, the Traffic Density Map project informs users in real-time and orients them to alternative routes to use road network capacity more efficiently. Moreover, the

MahallemIstanbul project provides information through web or mobile applications related to public/urban services at the neighborhood level.

4.8 Job availability indicator

The reorganization of the global economy has caused a necessity for new types of cities that has a major impact on social and cultural change, contributing especially to the emergence of a new class of highly qualified professionals, and the marginalization of the old industrial working class and immigrants, who are dismissed to low-paid jobs in the service economy (Shatkin, 2007).

In New York, the main motivations behind the creation of the smart city strategy are creating jobs, creating efficiencies, and attracting investment (ARUP, 2017). The share of adult workers in low-paying jobs is nearly 30% in the city (Hillard, González-Rivera & Sharp, 2018). Positions in the tertiary services sector were better paid in New York and London in comparison to Tokyo (Kubina et al.,2021). Hillard et al. (2018) state that a major new investment is unquestionably necessary for job training and workforce development programs in New York. The necessity for skilled and certified New Yorkers that go beyond a high school diploma has never been more to move ahead in today's economy. Moreover, growth is expected in clean energy jobs in New York State in the following years. Sectors including land-based wind energy, solar photovoltaics, battery energy storage, and utility-funded energy efficiency deployments have state-level employment growth potential for 2025 and 2030 (Moe &Turner, 2022). Taş (2022) states that technological developments necessitating a highly educated labor force are one of the major causes of growth in the relative demand for a skilled workforce.

Istanbul became a destination point for migrants from different cities in Turkey because of the diversity of the facilities and its job opportunities (Keskin, 2008). While agriculture had a portion of only 0.2% of the city's gross value added in 2011, the province's share (72.4%) exceeded Turkey's average considering services. In terms of manufacturing, Istanbul had very close figures (27.4%) to the country (İlk-

karacan, 2016 cited from TURKSTAT). Boz (2010) developed a job satisfaction index for the Istanbul labor market which consists of job benefits, income, weekend vacation, wishes for a child, and physical conditions of the workplace. A survey of 500 people from the industrial, agricultural, construction, and service sector showed that nearly half of the participants had low satisfaction levels with only 7 percent having high job satisfaction. İlkkaracan (2016) states that Istanbul's labor market is doing better regarding women compared with the country as a whole. However, it is still insufficient. Women's participation in the labor force is relatively low and there is a large gap of 43.5 percentage points with men. Besides, the unemployment rate among women is pretty high at 14.8%.

4.9 Transportation indicator

The experience of megacities in both developed and developing countries shows that sustainable mobility modes are necessary to reduce dependence on personal motorization and mitigate undesirable side effects (Batur &Koç, 2017).

New York has powerful strategies and policies related to improved public transport using Bus (transit signal priority), yellow taxis, and bicycle sharing (Razmjoo et al., 2022). It contains the largest public transportation system in America with bus networks, subway networks, ferry networks, and commuter railroad networks. Public transportation is quite crucial to enter the business center. Because three-quarters of the trips into the central business district are done by public transit (NYCDOT, nd). The mean travel time to get from home to work is 41,4 minutes (U.S. Census Bureau,2023). Moreover, New York City showed growth in bicycle usage by over 67% in March during COVID-19 mitigation and its success caused demands for permanent transformation to turn into a "bicycle city" (Moreno et al., 2021 cited from Hu). Sandy Storm damaged seriously various parts of the transportation system, caused disruption, and showed how the transportation system was central to the economy and functioning capabilities of the city. Therefore, the City aims to work for a more resilient transportation system (NYCDOT, nd).

Istanbul has very high levels of mobility, serious problems with heavy traffic (Erçetin, 2014), overloaded public transport services, and noise and air pollution (Canitez, Alpkokin, and Kiremitci, 2020). Bower (2018) explains that the largest part of Istanbul's Smarter City investments is used for metro projects. However, investments in public transportation and efficient policies were unsuccessful to satisfy the growing travel demands. As a result, motorization rates in the city have increased disturbingly to compensate for the deficiency, especially in the past years (Batur & Koç, 2017). Canitez et al. (2020) add that the megaprojects are largely driven by political and economic expectations which are sometimes conflicting with social and environmental sustainability policies. Bike-sharing system has been in service since May 2013 between Kadıköy and Kartal coastal line in Istanbul. However, this system is not based on a transport plan. Although policymakers intend to encourage cycling and create a culture for cycling through bike-sharing, apart from recreational aims, this pilot project has no visions for the improvement of widespread non-motorized transport involving pedestrian areas (Erçetin, 2014). Despite the major investments in infrastructure such as new tram and metro lines, a bus rapid transit line, and capacity growth in public bus networks have been applied in the last years, the objective to achieve a modal shift from car use to more sustainable transport forms such as walking, public transportation, and cycling is far from achieving (Canitez et al., 2020).

4.10 Water indicator

The accessibility to adequate clean and fresh water is essential for the health, social well-being, and economic development of any society. Increasing urban populations grow water demand and this leads to depletion of groundwater, saltwater intrusion, and water quality degradation from pollution and climate change. These threats position water regularly higher on the international agenda (Van Leeuwen & Sjerps, 2015).

New York has significantly reduced direct per capita water demand during recent decades (Krueger, McPhearson & Levin, 2022). This decline can be connected to various factors, such as greater ecological awareness of urban water managers, the realization of numerous user interests in the water resources and natural surroundings of the watershed area, in addition to the introduction of water metering in the 1990s (Krueger et al.,2022 cited from Soll). According to Rahm, Morse, Bowen, Choi, et al. (2018) New York State, USA, faces challenges in meeting wastewater treatment quality standards due to aging infrastructure, shifting demographics, increasingly stringent environmental regulations, and limited funding. Krueger et al. (2022) analyzed water supply security in New York City and its resilience to serious shocks and continuing disturbances. The results showed that water supply security remains high and existing response to shocks remains resilient because of past shock experiences.

Because of being far away from drinking water resources, scarcity of water has always been faced in the history of Istanbul (Van Leeuwen & Sjerps (2015) cite from Saatci). The authors state that illegal settlements in watershed zones created a threat to scarcity of water resources in the city. Despite large efforts, additional major transitions towards sustainable integrated water resources management are necessary for Istanbul because of the expected future population growth and climate change (Van Leeuwen & Sjerps (2015). Horizon 2020 project "BlueSCities" aims to give suggestions on the integration of water and waste into the Smart City policy and develop a tool to assess urban water management. The project suggests Blue City Index (0-10) where a higher score indicates a more sustainable urban water cycle. In this index, Istanbul achieves a score between 2-4 (KWR Water Research Institute, 2023).

4.11 Waste indicator

One of the major environmental problems is solid waste management in our age. While it continues to be a challenge for developed countries, it is an exponentially growing issue for developing countries (Goel, 2017).

The NYC suggested a plan in 2015 to reduce the volume of accumulated solid waste by 90% by 2030 and proposed the increase of reuse opportunities as one of its key drivers (Fortuna & Castaldi, 2018). Kontokosta, Hong, Johnson & Starobin (2018) studied the prediction of daily and weekly waste generation at the building scale in New York by combining machine learning and small-area estimation techniques. Shittu, Williams & Shaw (2021) state that the United States and Canada generate Waste from Electrical and Electronic Equipment (WEEE) ca.19-20kg/person/year. In both countries, there is WEEE-related legislation that differs from state to state in the USA. New York State's new regulations pay attention to reducing the use of polystyrene foam, waste from electrical and electronic equipment, and the prohibition of plastic bags (New York State, 2022).

14000 tons of solid waste is produced in Istanbul every day. While landfilling continues to be the main approach for municipal solid waste (MSW) treatment, biogas energy recovery and the proportion of biological waste/wastewater/sludge are still low in the city (Kanat,2010). The majority of the municipal and industrial solid wastes, mixed with hospital and hazardous wastes are dumped on the nearest lowlands and river valleys or into the sea in the Black Sea region of Turkey (Berkun, Aras, Nemlioglu, 2005). Moreover, healthcare waste management has not been conducted properly in the city. All of the healthcare wastes (i.e. infectious, domestic, and recyclable wastes) were collected together. There is a need to increase the waste volume in recycling. In addition, proper segregation should be performed via training, strict enforcement, and clear standards to reduce the volume of infectious wastes (Alagöz & Kocasoy, 2008). Besides, although MSW has improved in recent decades in Istanbul, there are still issues with MSW management and the protection of the environment (Kanat, 2010). Turkey published Zero Waste Regulation

in 2019 and Istanbul developed Zero Waste Management System Plan to provide a roadmap for the waste management stakeholders, to present the current situation, and to ensure gradual spread of the system in 2020.

5. Conclusion

Cities are places where problems such as air pollution, unemployment, migration, crime, and climate change not only arise but also find solutions. This study examined two global cities by considering some of the smart sustainable city indicators developed previously in the literature. The aim is to determine the strengths, weaknesses, commonalities, and differences between those cities that achieve unique positions in various smart and sustainable city indexes. For instance, while New York achieved 2nd place in the Global Power City Index and 15th place in Arcadis Sustainable Cities Index, Istanbul achieved 32nd place in the former, and 74th place in the latter. Ranking cities based on various indicators allows a comparison of cities' performances, measuring and monitoring their progress over the years. However, relying solely on ranking-based performance assessment may hinder seeing the opportunities and weaknesses of those cities on a deeper level. Therefore, by conducting a literature review on various smart sustainable city indicators, this study reveals where those cities can pay attention to perform better in terms of smartness and sustainability.

First, considering the studies in the literature, it is seen that New York has significant policies, plans, and strategies to achieve smart and sustainable cities. While New York is one of the most important centers controlling financial and commercial operations in the world, Istanbul aims to be one of the strategic actors in the global economy. However, it does not seem to have sufficient resources yet to be assertive concerning finance in the international arena. Economic development is one of the primary goals of the smart city system in New York, and technology is viewed as an enabler to achieve the ambitions of its economy. Second, income inequality appears to be an issue that needs to be solved in both cities. Besides, both cities

have a negative trade balance. Switzerland and China are two of the top import countries in Istanbul and New York. Third, a very significant rate of students in New York experience financial difficulties in education. In Istanbul, where the number of students is almost three times higher than in New York, the young population is an advantage whose potential has not been fully utilized. Moreover, in both cities, there are plans and projects to increase the share of renewables, notably in energy consumption. New York is the leading city in terms of green buildings compared to Istanbul. Considering health care, observing worse health conditions due to air pollution in neighborhoods with high poverty, lack of quality and affordability in health care, and the problem of many uninsured adults are some adressed challenges of New York in the literature. Besides, a research draws attention to the fact that it is necessary to resolve the imbalance of accessibility of health facilities in different districts in Istanbul. A summary can be found in Table 3 and Table 4.

While a study showed that strategically planned street lighting reduced nighttime outdoor crimes substantially, another study concluded that crime levels were much lower in New York during the Covid-related restrictions first. However, crime was rising again after a couple of months. On the other hand, another research pointed out that contrary to popular belief, Istanbul was not as unsafe as it appeared to be. In addition, regarding access to the Internet, it is seen that the rate of Internet access in residences are more than 85 percent in both cities. Besides, they had similar smart city services such as providing free WIFI access to its citizens. In New York, nearly a third of adults work in low-paying jobs. Nevertheless, New York's need for skilled labor increases and clean energy jobs are expected to expand in future years. In Istanbul, service workers are the big majority of the workforce, followed by manufacturing workers. A study on employee satisfaction from different sectors revealed that almost half of the employees have low job satisfaction in Istanbul. Apart from that, a study noted that the labor force participation rate of women is quite low in Istanbul.

While New York demands to become a "bicycle city" after the bicycle usage growth during Covid, another research explained that bicycle was preferred for recreational aims rather than as a means of transportation in Istanbul. New York has a highly developed transportation network. However, the severe affects of Hurricane Sandy and the likely affects of climate change on the transportation network encourage the stakeholders to make the system more resilient in the future.

Table 3: *Assessing New York and Istanbul based on indicators*

No	Indicator	New York	Istanbul
I1	Population	8,622,698 in 2020	15,907,951 in 2022
I2	Economy	one of the centers that control financial and commercial operations around the world (Portes & Martínez, 2019), income inequality (ARUP, 2017), 2.34 times more total imports than total exports in 2020 (Global EDGE, 2020).	Unsatisfactory resources for international competition concerning finance (Eren & Şimşek, 2016), income inequality (TUIK, 2022a), 1.79 times more imports than exports in 2023 (OEC, 2023).
I3	Education	1859 schools, 1,058,888 students in 2021-22, over 70 percent of students with financial difficulties (New York City Department of Education, 2023).	7437 schools, 3,175,285 students in 2019 (T.C.Istanbul Valiliği, 2019), young population is a notable advantage (Bulu et al., 2014).
I4	Energy	Powerful policies and strategies in the sector such as the wide application of renewable energy, green roof development, and the use of the energy-efficient streetlight system, important policies and strategies on smart infrastructure, improved infrastructure, and green buildings in the building sector (Razmjoo et al., 2022)	Significant improvement and structural reforms are neeeded regarding energy consumption, environment, constructing green energy-saving buildings, green action planning, environmental management, and public participation (Eren & Şimşek, 2016) .
I5	Health	161 hospitals in 2021 (Statista, 2023), high-poverty neighborhoods show higher baseline rates of various health conditions such as the ones connected with air pollution (NYC, 2022), many obstacles to getting quality and affordable health care, around 1 million of adults are uninsured (New York City Department of Health and Mental Hygiene, 2007).	234 hospitals in 2021 (The Ministry of Health, 2021), important differences between districts in terms of spatial accessibility to health facilities and proficiency rates make some districts disadvantageous (Paköz, 2014)
I6	Safety	Around 12% of index crimes occur outdoors and during night-time hours on public housing developments (Chalfin et al., 2022), weak capacity of law enforcement to limit crime levels (Kahn et al., 2022)	Lower crime rates in new districts and higher crime rates in the older districts that were closer to the center (Ergun & Yirmibeşoğlu, 2007).

Table 4 : *Assessing New York and Istanbul based on indicators (Part 2)*

No	Indicator	New York	Istanbul
I7	**Internet**	86.2% of households with a broadband Internet subscription (U.S. Census Bureau, 2023)	97.1% of households with Internet access (TUIK, 2021b)
I8	**Job availability**	Nearly 30% of adults work in low-paying jobs (Hillard et al., 2018), expected growth in clean energy jobs in New York State (Moe &Turner, 2022).	Share of service workers is 72.4% (İlkkaracan, 2016), a survey of 500 people showed that nearly half of the participants had low satisfaction levels (Boz, 2010), relatively low women participation in the labor force (İlkkaracan ,2016)
I9	**Transportation**	Largest public transportation system in America (NYCDOT, nd), growth in bicycle usage during COVID-19 mitigation and and demands to turn into a "bicycle city" (Moreno et al., 2021), aiming for a more resilient transportation system against storms such as Sandy (NYCDOT, nd).	Very high levels of mobility, serious problems with heavy traffic (Erçetin, 2014) ,unsuccessful investments in public transportation and inefficient policies to satisfy the growing travel demands (Batur & Koç, 2017), pilot projects for cycling serve more to recreational aims (Erçetin, 2014).
I10	**Water**	Significantly reduced direct per capita water demand during recent decades (Krueger et al., 2022), challenges in meeting wastewater treatment quality standards in New York State (Rahm et al., 2018), high water supply security and expected resilience to shocks due to past shock experiences (Krueger et al., 2022).	Scarcity of water, additional major transitions towards sustainable integrated water resources management are necessary (Van Leeuwen & Sjerps, 2015).
I11	**Waste**	A plan in 2015 aims to reduce the volume of accumulated solid waste by 90% (Fortuna & Castaldi, 2018), New York State's new regulations pay attention to reducing the use of polystyrene foam, waste from electrical and electronic equipment, and the prohibition of plastic bags (New York State, 2022).	Landfilling is the main approach for municipal solid waste treatment, and biogas energy recovery and the proportion of biological waste/wastewater/ sludge are still low (Kanat,2010), proper healthcare waste management is needed (Alagöz & Kocasoy, 2008).

Water demand in New York has been reported to have declined over the years, and a research claimed that New York City has a high water supply security and thanks to its previous experience it is expected to be resilient in the event of a shock. Another study mentioned New York State's struggle with wastewater treatment because of aging infrastructure, changing demographics, stringent environmental regulations, and limited resources. Considering Istanbul, water scarcity has always been an issue, and it seems that it will continue to be a problem in the future. A study indicated that the sustainability of Istanbul's water cycle was worse than the average. Last, New York has set zero waste targets by 2030. In addition, New York State has new regulations on the reduction of electrical, and electronic waste, polystyrene foam, and banning plastic carry-out bags. The preparation of the Zero Waste Management System Plan in Istanbul is an important step. Researchers point out that healthcare waste management and municipal waste management stages should be implemented more properly in the city.

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