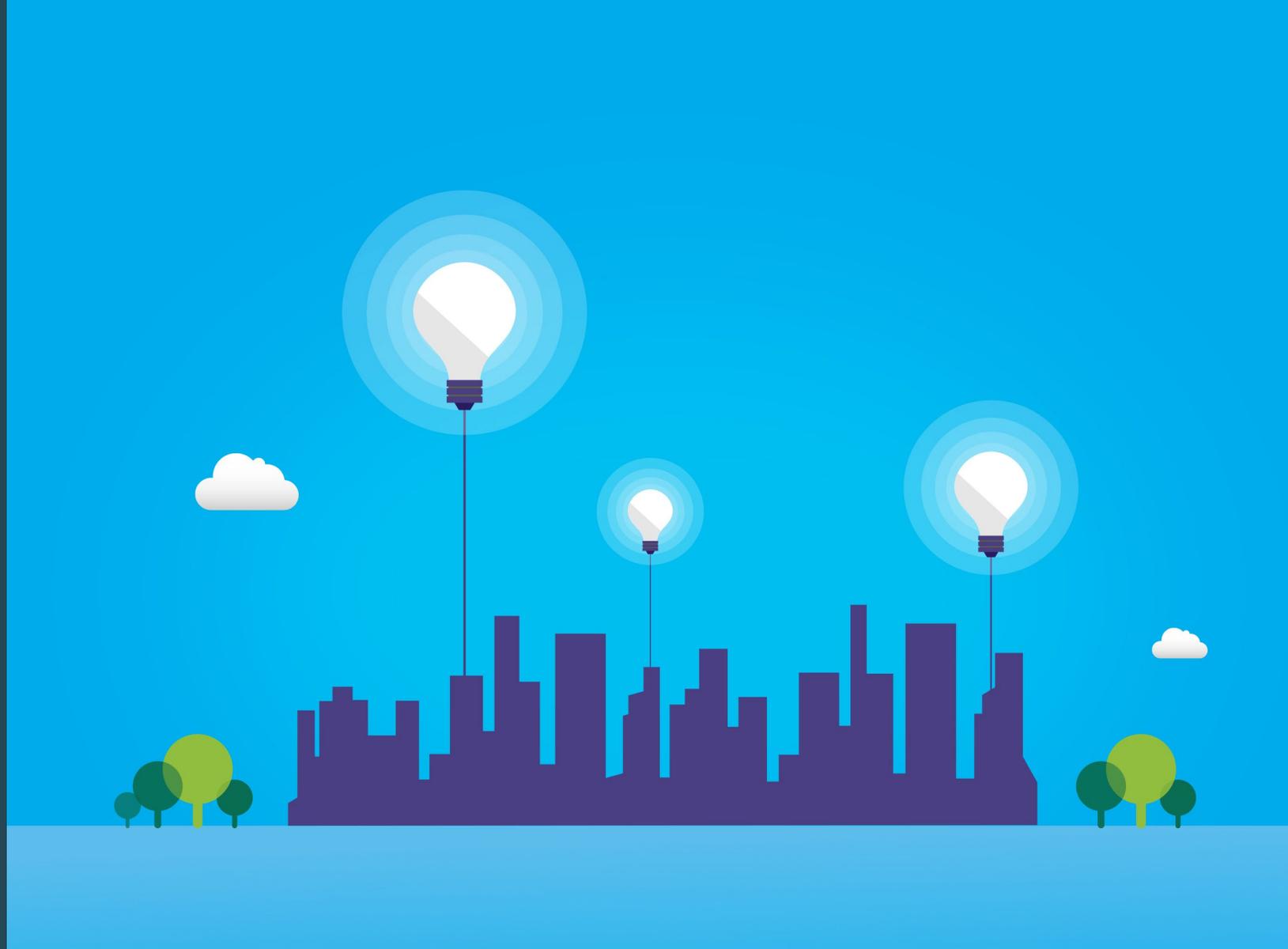


Smart City Solutions for a Riskier World

Spotlight on smart
sustainable cities

START



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Smart City Solutions

Cities across the globe are addressing the Sustainable Development Goals

COVID-19 has accelerated the need for cities around the world to adopt innovative solutions to achieve the UN's Sustainable Development Goals (SDGs). To help city leaders compare their progress against those of their peers, ESI ThoughtLab collaborated with a global coalition of business, government, and academic leaders to conduct a comprehensive benchmarking study of 167 cities across six world regions: Africa, Asia Pacific, Europe, Latin America, Middle East, and North America.

The study, **Smart City Solutions for a Riskier World**, examined how cities use digital technologies and data, together with public-private partnerships and policy initiatives, to achieve the SDGs. Cities that have made the most progress were classified as sprinters, and those making moderate progress or less progress were classified as advancers or implementers, respectively. In addition, sprinters that are also most ahead in smart city innovation were classified as more advanced Cities 4.0.

This report showcases how 10 cities—across regions, population sizes, and economic maturity—are achieving the SDGs. It spotlights challenges and solutions and provides valuable insights for their peers.

Accra and **Bogota** are addressing problems common to developing countries, such as securing funding for SDG initiatives, gaining access to data needed for efficient decision-making, and coping with mobility problems.

Ludhiana sheds light on how emerging market cities need to navigate through the pandemic to get their sustainability plans back on track.

Barcelona, **Orlando**, and **Philadelphia** are Cities 4.0—smartly using technology and partnerships to advance their SDG agendas. They are leveraging their urban ecosystems to build more digitally focused, diversified economies. In addition to partnerships, **Trondheim** is blazing a trail on using data and metrics to deliver on the SDGs.

Porto shows how a city can use digital twins and other advanced technology to revamp its water system.

Torrance, a smaller city in California, showcases the value of resilience and agility in the face of multiple disruptions, including a major cyberattack. **Suzhou** exemplifies a city on the fast track to becoming a City 4.0.



[Accra ↔](#)



[Barcelona ↔](#)



[Bogota ↔](#)



[Ludhiana ↔](#)



[Orlando ↔](#)



[Philadelphia ↔](#)



[Porto ↔](#)



[Suzhou ↔](#)



[Torrance ↔](#)



[Trondheim ↔](#)

Accra: Leading in Africa

Best practices and citizen engagement put Accra ahead

Accra, Ghana stands out ahead of the other African cities in our study in advancing its SDG agenda. It is the only city in the region classified as a “sprinter”—among those making considerable progress on its social, environmental, and economic goals.

Africa faces the most challenges of any region in meeting the UN’s SDG commitments, given its high levels of environmental degradation, poverty, and unemployment, along with rapid population growth and weak state institutions. In our benchmarking study of SDG progress across 167 cities, African municipalities generally trailed behind cities in all other regions.

Yet Accra has done better than the other 19 African cities studied. What has it done differently? It has

incorporated all the 17 SDGs into its development plans, which has been done by only one other African city, Kigali. In addition, Accra has made considerable progress on 14 of the SDGs, more than any other city in the region.

Accra also has followed several critical steps that can help ensure the success of an SDG program. It has secured a high level of support for the SDGs across government departments; it regularly monitors SDG efforts; and it has designated a specific department to take the lead on SDG initiatives. It also is using smart technology solutions across more urban domains than other African cities. And it has made important headway on citizen engagement—another key component of SDG achievement.

Addressing the waste challenge

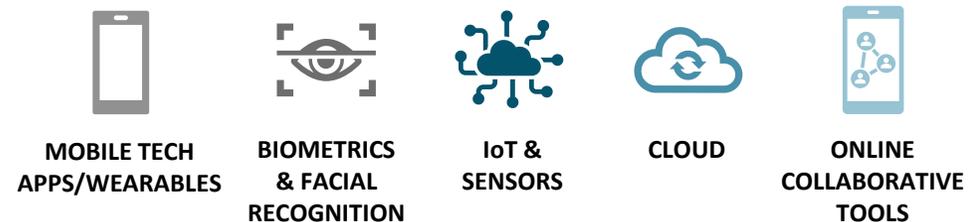
Environmental sustainability, particularly related to clean water and sanitation (SDG 6), is one area where Accra has adopted bold initiatives. The government has committed to make Accra one of the cleanest cities in Africa, and in 2019 it drafted a new national plastics management policy to reduce plastics pollution. The policy was designed to promote recycling of plastic waste into other products as well as to begin an intensive environmental education program. In 2019 Ghana also became the first African nation to join the Global Plastic Action Partnership (GPAP), a public-private platform dedicated to fostering action to combat the plastics pollution crisis. The GPAP is supporting the mobilization of \$77 million towards the establishment of a Circular Economy Framework in Ghana, in collaboration with the Global Environment Facility, the United Nations Industrial Development Organization, and the Ghanaian government.



How Accra engages citizens

Reaches out to stakeholders to demonstrate the value of smart city projects	Uses digital and traditional methods to communicate with citizens	Ensures disadvantaged populations are involved in the process	Encourages citizens to use digital engagement tools
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Where Accra has made large technology investments



A proactive approach to funding the SDGs

Funding of SDGs programs is one of the biggest challenges for African cities, but it is an area where Accra stands out.

In 2018, Ghana's Ministry of Finance, in collaboration with the Ghana Investment Promotions Centre and the SDGs Advisory Unit, launched the annual Accra SDGs Investment Fair to encourage private financing of SDG programs. The fair was created to facilitate collaboration between investors and sustainable public- and private-sector projects and businesses. The most recent fair, in 2020, was conducted virtually and was designed to develop post-COVID-19 funding strategies, since the pandemic further squeezed already constrained public finances.

Seeking impact investors

In 2019, Ghana joined the Global Steering Group for Impact Investing, an entity formed by the G7 countries in 2013 to jumpstart the development and collaboration of impact investing to fund social and environmental projects. Ghana was only the second Sub-Saharan African country, after South Africa, to join. Zambia became the third.

The same year, Ghana founded Impact Investing Ghana (IIGH), a community of members and a platform to bring together entrepreneurs, intermediaries, suppliers of capital, policy-makers, market builders, and other stakeholders such as faith-based and civil society organizations.

SDGs Financing Roundtable

Subsequently, in 2020, the government joined the Sustainable Development Investment Partnership (SDIP), an initiative of the World Economic Forum and the OECD, to hold the first SDGs Country Financing Roadmap Roundtable in Accra. It was the first African country to partner with the SDIP.

The event brought together governmental institutions, donors, multilateral organizations, development banks, and private investors to investigate innovative methods to finance the SDGs, including foreign investment and private equity.

While this funding strategy was initiated at the national level, Ghana's government also engages leaders at the local level. The SDGs national budgeting and financing process involves a bottom-up approach where local authorities actively participate.

Diversifying financing

In addition to these national efforts, Accra's leaders are seeking to diversify their sources of financing. According to our survey, the main sources of funding now for Accra are multilateral financing, government-based borrowing, and user fees taxes. Over the next three years, multilateral financing will remain vital for the city, but private-sector financing and crowdsourcing from the public will grow in importance.

Accra's main sources of financing now and in 3 years

Now	In three years
Government-based borrowing	Private-sector financing
Funding through user fees/taxes	Multilateral and development funding
Multilateral and development funding	Crowdfunding from public in small amounts

Accra's top challenges to achieving the SDGs

 High costs and financing constraints	 Weak economy/ high unemployment
 Finding the right suppliers and partners	 Fast pace of technologic change

“What we cannot afford to do, even in these critical times, is shift resources away from crucial SDG actions. The response to the pandemic cannot be de-linked from the SDGs. Indeed, achieving the SDGs will put us on a firm path to dealing with global health risks and emerging infectious diseases. Achieving SDG 3 (Good Health) will mean strengthening the capacity of countries for early warning, risk reduction, and management of national and global health risks.”

–Nana Addo Dankwa Akufo-Addo, President of the Republic of Ghana (Opinion piece for Thompson Reuters Foundation)

Barcelona and the pandemic

Planning recovery around the SDGs

Strict travel restrictions and containment measures to slow the spread of COVID-19 damaged tourism-fueled economies like that of Barcelona. In working through the pandemic's impacts and planning for recovery, the city kept its economic as well as its social and environmental goals in mind.

Supported by a healthy budget and the absence of debt, Barcelona was able to tap robust resources to decrease infections and support residents economically as unemployment rates soared.

The city's main priority was to help the healthcare system, by transforming existing spaces like sports centers and public buildings into hospitals and shelters. Outside of health-related issues, the city's projects around sustainability and the UN's 2030 Agenda initially took a back seat.

"We were thinking about the next 24 hours, not the next 10 years," said Miquel Rodriguez Planas, commissioner for the 2030 Agenda of the Barcelona City Council. "But once we got to a 'new normality,' we realized that the challenges we had with the pandemic, the need for a good health system, good education, less inequality, a more resilient economy, were already part of the 2030 Agenda. With the pandemic, we just believe more in the agenda."

Diversifying the economy

One of the first lessons from the pandemic for Barcelona was the need to reduce its reliance on tourism. The collapse of tourism from the lockdowns hurt retailers in the city center,

which suddenly lost most of their customers. The city's post-pandemic objective is to make the economy more resilient, by diversifying into other areas, like education. With five top public universities and two top business schools, the city aims to develop a knowledge-based economy appealing to students and faculty from all over the world.

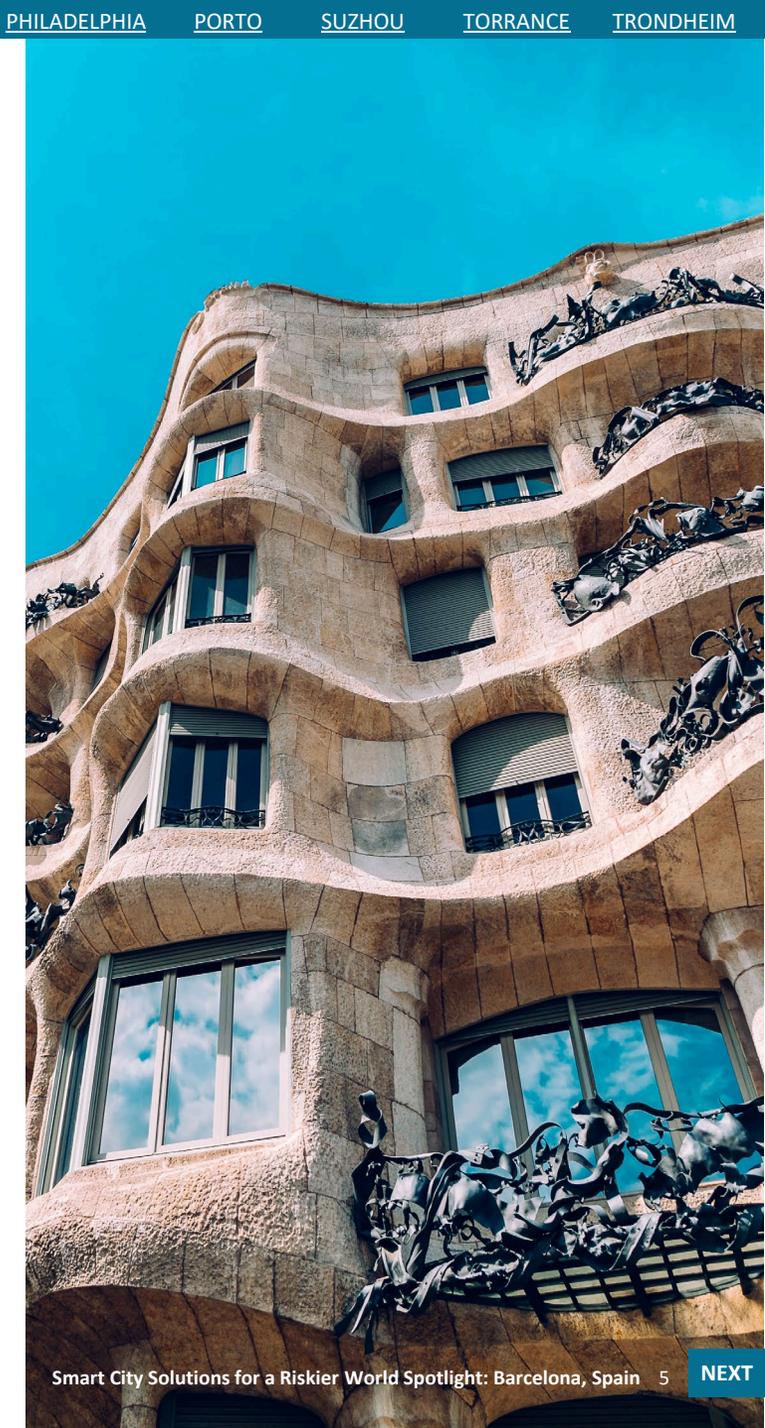
Barcelona also will focus on attracting more energy firms, pharmaceutical players, and other businesses to its Tech City, a non-profit organization that supports entrepreneurs, investors, incubators, government entities, and others working to build Barcelona into a major global tech hub.

"To survive, we need to diversify the economy and have a bold policy to build a talent-driven, knowledge economy. We have the assets, we just need to connect them with the research centers, the SMEs, and the private sector," said Rodriguez Planas.

To address rising unemployment among blue-collar workers from the hospitality and retail sectors, the city is investing in training programs. For instance, a public IT Academy currently teaches programming skills to over 300 students per year, a number the city hopes will go up to 3,000 per year.

"If we want to have an economy based on innovation and added value, and to reduce inequalities, we need to provide new skills and opportunities to residents."

—Miquel Rodriguez Planas, Commissioner for 2030 Agenda, Barcelona City Council



Addressing the digital gap and sustainable energy

The pandemic highlighted inequalities in digital access. With the sudden jump in remote working and education, and the shift to digital for many public- and private-sector services, Barcelona had to assess and bridge gaps in digital connectivity.

The city conducted a citizen [survey](#) published in January 2021 which determined that 92% of residents had access to the Internet. While this is a relatively high level, it still left 8% of households disconnected, and 55% of these comprised people 74 years of age or older. The study also confirmed a sharp increase in technology use during the pandemic as workers and students went remote.

Armed with this data, the city launched initiatives to boost digital access, for instance by donating devices to families or deploying “digital agents”

to help residents use technology, particularly seniors. “To me, a smart city is a city that knows which challenges its citizens are facing and tries to solve them,” said Rodriguez Planas.

Partnering for sustainable energy

In line with the SDGs, the city is also focusing on the environment. It has allocated €50 million for solar panel projects, working with private partners to install panels on the roofs of residential, industrial, and other buildings. The city will fund just 30% of the projects, with private companies investing the rest—highlighting its approach of working in partnership with the private sector as much as possible.

The city hopes to generate revenue from these initiatives and achieve a sizable return on its investments, helping to heal its budget.

“We don’t put technology at the top of our agenda. We focus more on public-private partnerships. To pursue the right policies, to speed up recovery, we need the private sector. Not only for resources, but also for the model or design of policies. Sometimes when the private sector helps design the policies, they bring the technology as well.”

–Miquel Rodriguez Planas, 2030 Agenda Commissioner, Barcelona City Council

Barcelona’s biggest lessons from the pandemic

Timely access to data and advanced analytics is crucial for running today’s city

Cities need to pay more attention to the health and well-being of all citizens

Our city needs to ensure that employees have the devices and digital access for working from home

Cities need to invest in upgrading core infrastructure

Technology solutions where Barcelona is making large investments



Data to redesign public welfare programs



Remote medicine & telehealth services



Online government benefits portal



Real-time air-quality information



Data on infectious & epidemic diseases



[Watch here](#)

Mobility in Bogota

Making transportation smarter and more sustainable

Bogota, Colombia has made more progress than most cities in achieving the UN's SDGs, qualifying it as a "sprinter" among the 167 cities benchmarked in our survey. Its efforts around mobility are best in class.

Mobility is a key area of focus for cities globally as a result of the pandemic. Of the city leaders surveyed, 55% said the health crisis had caused them to reconsider mobility and transportation to accommodate changing citizen behaviors. Bogota's leader was one of them.

Grappling with congestion

With 7.8 million inhabitants and 1.2 million vehicles, the Bogota metropolitan area has been suffering from heavy traffic, congestion, and related pollution since the 1990s. According to the [2019 Global Traffic Scorecard](#), Bogota had the dubious distinction of having the worst traffic congestion in the world, causing drivers to lose an average of 191 hours a year on the road.

According to a [mobility survey](#) conducted in 2019 by the city, sustainable travel went from a 72% share of all city journeys in 2011 to 67% in 2019, a trend that worried city leaders. The same year, the city launched [an investment project](#) to develop a roadmap to determine the causes of this decline and promote more equitable and clean transportation.

The research showed that residents' experience with public transportation had become increasingly unsatisfactory, particularly for the most vulnerable citizens who had restricted access to the city's goods and services. Respondents cited the transportation system's low coverage and frequency as main problems, causing long waiting times and many transfers between different modes of transportation.

A multi-faceted approach

Equipped with this information, city leaders drew up a mobility plan that promoted several of the goals of the UN's Agenda 2030, including reduced inequalities, sustainable cities, and climate action. The city's resolutions included reducing the monetary burden of transportation for low-income households and improving the "time of access" to public transportation (a figure calculated based on the walking time to and waiting time at stations and stops).

In addition, Bogota's public transport authority added 596 electric buses to its fleet in the first week of 2021, bringing it to a total of 1,485 electric buses. This investment elevates Bogota to the city with the most electric buses in the world, outside of China. This will allow the city to eliminate [83,433 tons of carbon dioxide](#) and 9.63 tons of particle emissions each year.

Mobility in Bogota by the numbers

\$1.8bn

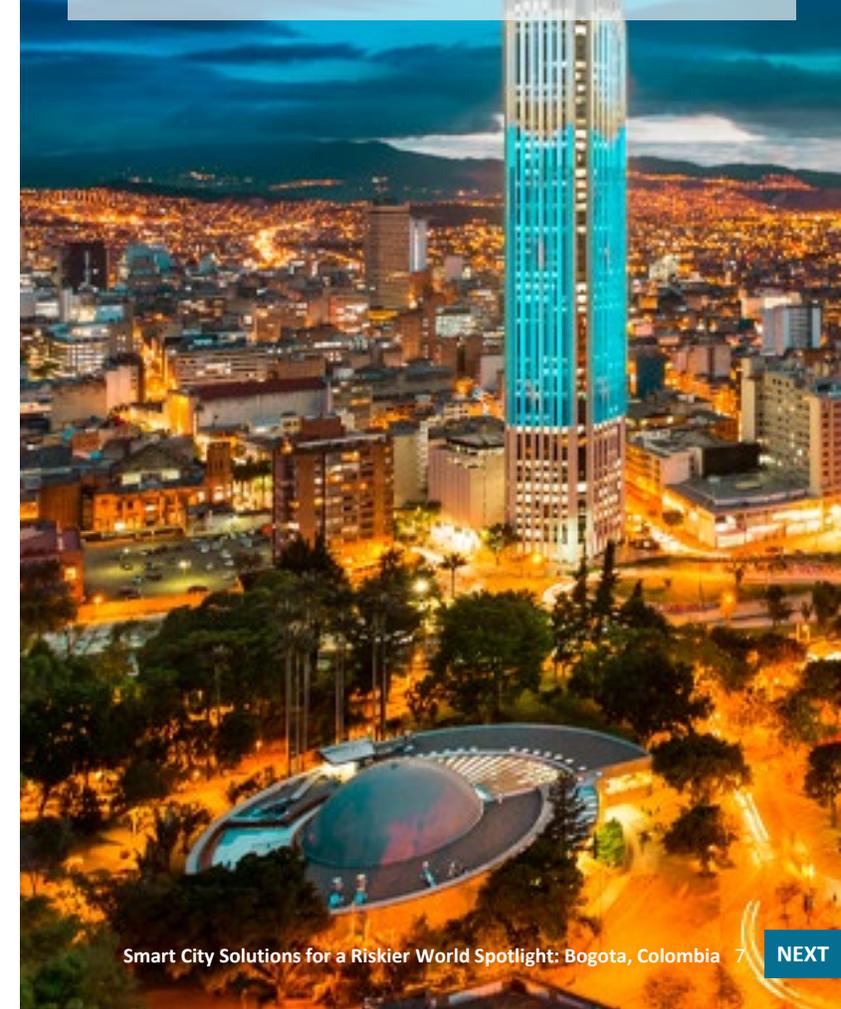
economic cost of traffic
each year

60%

% of vehicles on the road
that are private cars

191 hrs.

wasted in traffic on the road per driver each year



Real-time data is key for mobility solutions

Bogota has learned that data is a powerful tool for pinpointing and addressing its most pressing transportation problems.

According to Grace Quintana, a city leader in digital government and transformation, one of the biggest challenges to solving mobility problems was acquiring and utilizing the real-time data needed to create an efficient government plan.

The city created an open data model called GAQO, the acronym for Governance, Administration, Quality, and Optimization of data. The tool was designed to facilitate the use of data to solve any kind of problem in Bogota, particularly in the public sector. For instance, officials are in the process of implementing GAQO in the National Health Superintendency.

“GAQO created a roadmap detailing what our problems are and what kind of data can help respond to them. For instance, how many cars are in Bogota, where do accidents happen, at what time, what color are the cars,” said Quintana.

City officials conducted a mobility study utilizing GAQO that helped to determine a key data point to reduce congestion: 65% of car trips in Bogota involve only one or two passengers, a factor that increases traffic dramatically in a city where 60% of vehicles traveling on the road are private. The data revealed that heavy load vehicles were not primarily

responsible for Bogota’s traffic jams as was originally thought; instead, the main culprit was private cars.

Tapping IoT

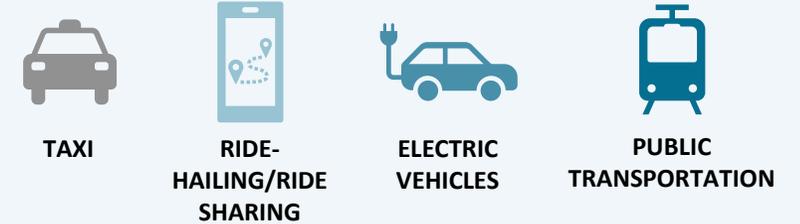
To help with its data collection, Bogota has turned to IoT. In 2019, it partnered with World Sensing (a Spanish IoT company specializing in sensing solutions for smart cities) to develop one of the most advanced mobility management solutions in the world. It integrates data from traffic lights, bus stops, traffic cameras, bicycle lanes, and other elements to provide a comprehensive understanding of urban mobility that enables real-time management.

The data culled through these efforts allowed Quintana to pursue a range of solutions to address congestion as well as to reduce greenhouse gas emissions, improve the city’s air quality, and minimize road accidents.

“It’s important to make data open, available, and useful to people. GAQO ensures that no data is wasted and that we are utilizing it to satisfy the need for information and to solve issues. This model generates value for the government, giving us the ability to improve products and services.”

—Grace Quintana, City Leader, Bogota

Most important modes of transportation in Bogota



Most effective steps Bogota is taking to improve mobility

Use data and analytics for transportation planning	Work with nearby cities to develop trans-border transportation infrastructure	Work with freight delivery and local businesses on smart distribution solutions	Introduce policies to reduce emissions and improve air quality	Create a long-term multi-modal urban mobility vision and plan
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Mobility technology

Where Bogota is making large investments

Smart traffic signals/real-time traffic management	Real-time public transportation app/information	Public electric vehicle charging infrastructure
Mobility as a service (MaaS) apps	Digital transit payments/open-loop systems	Demand-based micro transit (ride-sharing, shuttle vans)

Ludhiana: Lessons from a developing city

How the pandemic reinforced the SDG imperative

Ludhiana, classified as an SDG advancer city in our study, is one of the most vibrant industrial cities in India. Prior to the pandemic, Ludhiana was acting on the SDGs. COVID-19 was a detour on its path to sustainability, but also an incentive to move forward.

As one of the biggest cities in Punjab state, Ludhiana has a large market for skilled and semiskilled workers. It manufactures half of the bicycles used in India and is a major producer of auto parts and garments.

Ludhiana had already begun to address poverty, public safety, pollution, and other SDGs before the pandemic hit. The city spent months collecting data on mobility and transportation, followed by focus group discussions with drivers, union heads, and users to draw a comprehensive picture of the city's transportation problems. City planners had many ambitious decongestion initiatives in their sights, from improving road demarcation to upgrading road networks and pedestrian areas.

Facing the pandemic

When the crisis spread, many jobs were lost. "The major impact of COVID was unemployment. People everywhere were fired as companies were not getting enough revenue," said Abhishek Sharma, Ludhiana's city manager. "For a city that is very big on industrial work and manufacturing, it was a disaster."

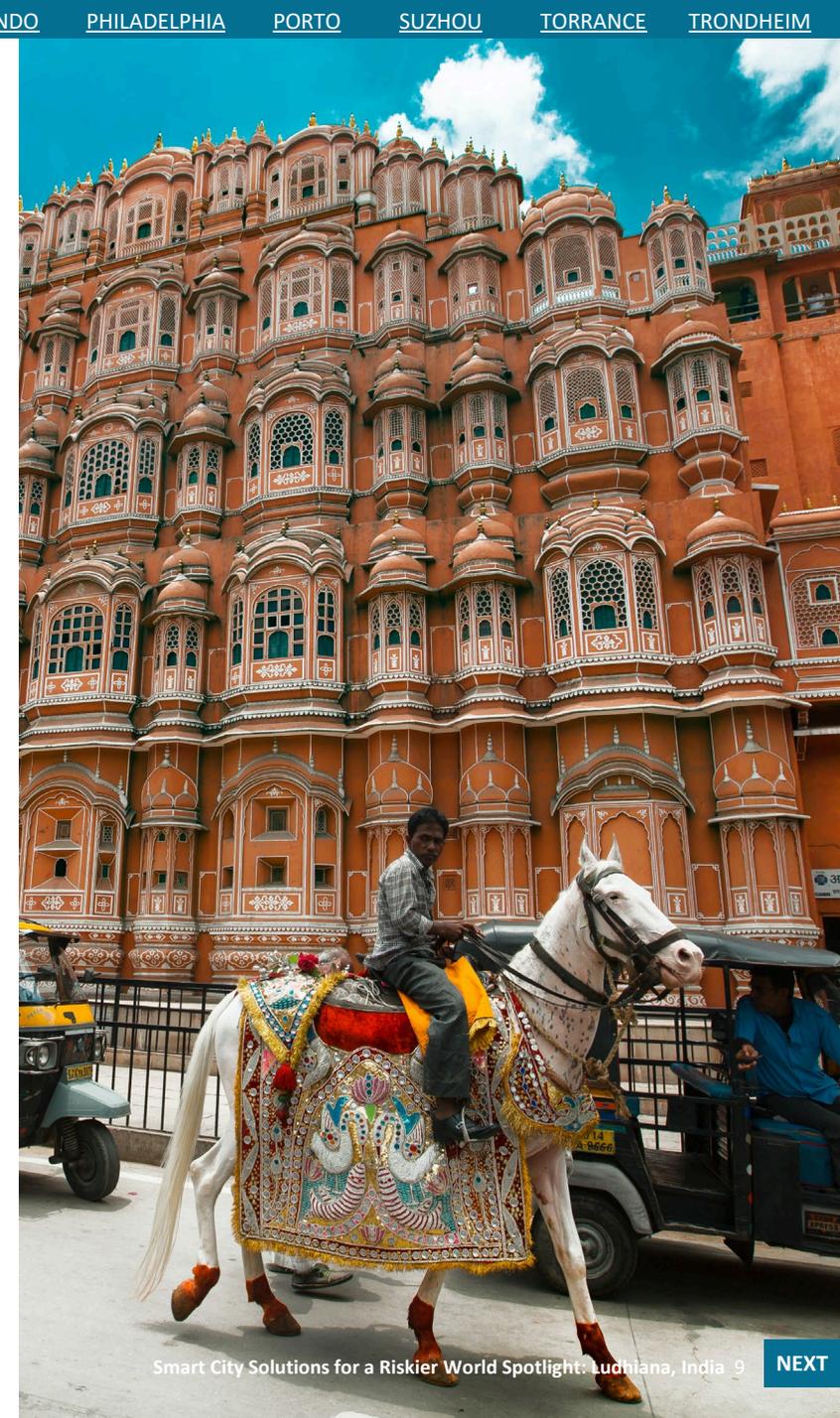
The city's first move was to fortify its healthcare system. With its limited resources and personnel, improving access to good healthcare was already a goal for the city before 2020, but the pandemic heightened the urgency. The city worked to boost healthcare resources and to digitize many services.

"We are focusing on online appointments so that people don't come in at once, and so they don't wait for a long period of time," said Sharma. "We have started this service, but people don't always know how the process works, so we are planning educational campaigns."

Education was another city imperative as students, confined to their homes, had to rely on online learning. The city invested in improving its network infrastructure to address residents' complaints about poor connectivity. To facilitate online learning, schools brought in an array of [new technologies](#), such as smart projectors, computers, and TVs.

"Before the pandemic, we were improvising day by day. This was the biggest lesson: we shouldn't improvise in our city. We must focus on technology and infrastructure so that people stay here, work here, and also come from other states."

—Abhishek Sharma, City Manager, Ludhiana



On the road to “Digital India”

Among its many impacts, the pandemic also increased the priority placed on Ludhiana’s digital plans.

The crisis underscored the need to provide more reliable and affordable Internet access and mobile connectivity to citizens and businesses, as well as to invest in digital transformation.

“India is trying to become Digital India. This is not a priority just for our city; all over the country we are focusing on the Digital India program led by the prime minister,” said Sharma.

Launched in 2015, the country designed the [Digital India](#) campaign to support its transition to a more digital economy by improving online infrastructure and connectivity. The program also focuses on providing government services online and improving digital literacy. With over [560 million](#) Internet subscribers in 2018, India is the second largest and fastest-growing market for digital consumers. The campaign’s goal is also

to reduce the digital gap and provide connectivity to all citizens. But for Ludhiana, as with other emerging market cities, money stands in the way.

“Whether we need to build a bridge or improve our educational system, we always need funding from the government,” said Sharma. “Everything depends on funding and how it is being utilized, how long we have to wait for that funding, and how we are going to implement it.”

Looking ahead

Today, as Ludhiana gradually recovers and [provides its residents](#) with the COVID-19 vaccine, the lessons learned will carry over into future initiatives. The city is already planning infrastructure projects focused on avoiding sea level rises during the rainy season, which impacts the city’s mobility and damages housing. Most of all, city leaders recognize the vital role that digitization will play in future urban plans.

Ludhiana’s biggest lessons from the pandemic

Smart city programs and digital transformation are crucial for the future of our city

Business and government need to collaborate more closely to address today’s issues

Operational continuity planning and agility are critical in today’s fast-changing world

A resilient ecosystem of suppliers and partners is vital to cope with unexpected, disruptive events

Cities need to provide more reliable and affordable Internet and mobile connectivity to citizens and businesses

Ludhiana’s biggest technology investments

Now	In three years
IoT & sensors	Cloud
Cloud	AI
AI	IoT & sensors
Telematics and geospatial	Blockchain
Online collaborative tools	Telematics and geospatial
Digital dashboards & real-time data tracking	Mobile/apps
Data management center	Digital dashboards & real-time data tracking
Digital twins	Biometrics
	Data management center

Ludhiana’s investment priorities



MOBILITY & TRANSPORTATION



GOVERNMENT & EDUCATION



ENERGY, WATER, & OTHER UTILITIES



DIGITAL INFRASTRUCTURE & NETWORKS

Orlando: Creating a sustainable network

A regional approach to the SDGs

Orlando, Florida has long been a leader in sustainable practices. What also sets the city apart is an unwavering commitment to regional collaboration for achieving the SDGs, a mission that became even more pressing when the COVID-19 pandemic erupted.

Orlando uses the SDGs as a framework for its development policies, and underpins this with a strong culture of collaboration, according to Chris Castro, the city's director of sustainability and resilience. Indeed, Orlando is the only North American city in our survey that partners with every level of government—from state to federal—as well as other actors to achieve its goals.

Setting up a regional collaborative

In 2018, Orlando approached the East Central Florida Regional Planning Council to work together on climate and resilience. The city mobilized several committees to bring forward a resolution for city councils in the region to pass to officially join the collaborative, called the East Central Florida Regional Resilience collaborative (or R2C).

To date, almost 40 government partners have joined, making it one of the largest resilience and climate collaboratives in the US.

“It’s rooted in the triple bottom line of people, places, and prosperity,” said Castro. “It’s very focused on natural and built environment. It’s focused on economic prosperity,

health, and equity. The SDGs and the metrics of the SDGs are how we’re starting to track and monitor progress towards those goals.”

The collaborative not only comprises government actors, it’s also cross-sectoral. Partnerships with universities have enabled the city to tap the expertise of academics, researchers, and students. The University of Central Florida, for instance, created a center of excellence around the SDGs, the Global Economics and Environmental Opportunity (GEEO), that weaves the SDGs across the entire curriculum. It also operates across colleges, and involves faculty, staff, and community scholars.

The collaborative is also pushing for smaller municipalities in the region to appoint an expert in charge of sustainability. A grant from Audubon Florida enabled the collaborative to fund one full-time position for one year in up to 20 local governments.

“We’re really a catalyst to get other counties and smaller cities to see the importance of the SDGs, to see the value proposition. We do a lot of education around different types of interventions or investments that we’ve made that have shown good economic results and address climate and public health.”

—Chris Castro, Director of Sustainability and Resilience, City of Orlando



Tracking SDG progress

With only ten years left to deliver on the UN's 2030 Agenda, cities like Orlando are eager to implement metrics and systems for tracking progress against their sustainability goals.

Orlando is in the process of publishing its first Voluntary Local Review (VLR), a roadmap that monitors SDG progress in detail, while also establishing guidelines for future planning and budgeting.

For its first VLR, Orlando chose to focus on nine of the SDGs, including affordable clean energy (7), health and well-being (3), and partnerships for the goals (17).

Goal 10, which tackles inequality, also has been a priority for the city, particularly during the

“I think we’re seeing the highest returns on the momentum building in our community around centering the SDGs as a recovery framework. It’s incredible to have a university and a college, to have the city and now the county updating their plans to include the SDGs.”

–Chris Castro, Director of Sustainability and Resilience, City of Orlando.

pandemic. Orlando is investing heavily to address the digital divide by setting up hotspots for high-speed broadband and a tablet checkout program in 19 neighborhood and community centers around the city. The initiative allows residents to connect to multiple services in the community and simultaneously supports the city’s financial literacy efforts.

“It’s needed now more than ever. For people who have multiple kids at home that are still virtual, it’s really a challenging time,” said Castro. “We’re excited to be able to help, and I’m sure the visibility and interest in this program is going to be tremendous.”



[Watch here](#)

How Orlando works with its ecosystem to achieve its goals

Uses open and flexible RFPs to consider innovative solutions.	Engages with other cities to share best practices.	Develops the skills, capabilities, and culture to work with external ecosystems.	Uses PPP schemes to bring in private-sector investment.
Appoints a champion to build key partnerships.	Monitors progress and challenges with partnerships and make ongoing improvements .	Opens pitching sessions for potential partners to provide ideas to the city.	Builds a shared vision, responsibilities, and accountabilities with partners.

Orlando’s biggest lessons from the pandemic

Business and government need to collaborate more closely to address today's issues.	Cities need to pay more attention to the health and well-being of all citizens.	Cities need to ensure that their investments benefit all citizens, especially the most vulnerable.	Private and public-sector organizations need to take a 'triple bottom line' perspective that considers social, environmental, and financial value.
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Tackling the digital divide in Philadelphia

Doing more with less

The COVID-19 pandemic amplified the challenges that cities were confronting before 2020 and created new ones. For Philadelphia, it deepened the commitment to provide connectivity and digital tools to citizens.

The pandemic is one of the top three disruptions that Philadelphia faces today, alongside social unrest and deglobalization, according to our survey of 167 cities worldwide. With more people studying and working from home than ever before, providing digital access has been one of the city's priorities, but also a difficulty because of limited funding.

“Philly is not unique in the crises we face, just the setting. We have our challenge of being the largest poor city in the US, and of having massive budget cuts,” said Emily Yates, smart city director for the city of Philadelphia. “The need to do more with less for more people now is a big challenge.”

Connecting the city

Before COVID, the city knew that approximately a quarter of the population didn't have quality access to the Internet. When the pandemic hit, those residents had to transition to remote learning and working with low connectivity. Many also didn't own essential tools like desktop or laptop computers. For families with several people at home, the challenge was even greater. The city has deployed several pilots to address the digital divide while also promoting sustainability.

Partnering with a company that provides a no-contact pick-up system, the city began collecting unwanted computers from city residents and businesses and sharing them with local refurbishers. The partnership, called PHL-Donate-Tech, collected over 600 computers in less than two months and donated them to citizens in need.

Another initiative, PHL-Connected, is tackling the same issue but focuses on K-12 students. Partnering with Comcast Internet Essentials and T-Mobile hotspots, the city raised enough funding to connect any students who were without reliable and consistent Internet connections. The hotspots were particularly important in providing Internet service to housing insecure families, which face an added obstacle to connectivity.

With the same approach of utilizing tools the city already has, Philadelphia is exploring how to leverage infrastructure and assets to provide more connectivity options, such as placing Wi-Fi towers on rooftops.

“Despite reducing the cost barrier, there are still many obstacles to getting folks connected. Some of that is on our end, some of it is just the complications of the Internet, and some of it is just the complications of people's lives and whether they are able to actually complete the process and get logged on.”

—Juliet Fink Yates, Digital Inclusion Fellow, Philadelphia



New opportunities created by the pandemic

Despite the hardship it created, the pandemic encouraged donors to help city leaders cope with the digital divide and drive other sustainability initiatives.

“Everyone came to us and asked how we were going to get people connected. We were doing this for a long time and couldn’t get others to pay attention to this issue,” said Fink Yates. “Suddenly funders were interested, and the different ISPs and telecoms firms wanted to do more. It really opened the doors for talking about this issue at all levels of government and across the city.”

Even as Philadelphia looks to the future with new projects in place, and there is renewed attention

from donors and others in the community, it still needs to work on challenges such as coordinating its initiatives, according to Andrew Buss, the city’s deputy CIO for innovation management. The city has traditionally undertaken many projects but will need to coordinate across its network to work between departments and collectively advocate for funding.

“From a sustainability perspective, that’s really the key for me. It’s what I always call the people infrastructure. I think that’s true for all the other work we do in our group, not just digital equity,” said Buss.

Circular construction in Philadelphia

Another project the city is developing is a tool around urban mining and data. Using data collected, the city can identify where waste is being created based on housing types, where there is a demand for reused material, and which materials are the most valuable. The hope is that the waste is allocated to where it’s needed. The goal also is to help facilitate a circular construction and demolition waste stream that will create jobs and reduce waste going to landfills. This is an important project given that construction is one of the largest contributors to greenhouse gas emissions.

“Often smart cities are not getting at the structural inequities that we see. They’re not leveraging data to really dig down and peel back the layers of how the city’s been operating and how we can move forward in a more effective and strategic way to address inequities.”

–Emily Yates, Smart City Director, City of Philadelphia

Philadelphia’s main challenges in achieving the SDGs

Unclear implementation roadmap and ROI	Inadequate data, analytical, and planning tools	Difficulty coordinating efforts across city departments
Data security and privacy risks	Complex policies, regulations, and procurement procedures	

Philadelphia’s biggest lessons from the pandemic

Smart city programs and digital transformation are crucial for the future of our city	Operational continuity planning and agility are critical in today’s fast-changing world	Flexible and remote working can improve employee productivity and engagement	Crisis management and emotional intelligence are vital skills for city leaders and workers
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Porto's smart water management

How a digital twin transformed the city's water system

Porto, Portugal stands out among cities in Europe in its dedication to using cutting-edge technology to become more environmentally and socially responsible.

In 2020, Porto was selected by the European Commission to be part of the “Intelligent Cities Challenge,” an initiative to support and transform 120 cities into smart and sustainable urban centers. One example of Porto's successes is its use of smart technology to improve its urban water system.

Agua do Porto (AdP), the city's public water utility, is responsible for water supply, wastewater drainage and treatment, and stormwater treatment. As the company's hydraulic infrastructure grew increasingly complex, it needed a holistic, integrated, and sustainable way to access data and manage its water cycle, including to forecast flood risks and water quality issues, and improve decision-making and system resilience.

Agua do Porto's digital twin

To do so, the city commissioned a group of vendors to create a single, smart water management platform called H2Porto. The consortium—which included Bentley, Aqualogus, A2O, and other partners—integrated all data sources, including

geospatial information systems, real-time network sensors, household meters, laboratory, billing, work orders, and logistics into H2Porto.

This digital twin can model water levels based on real-world conditions and weather forecasts to predict flooding and other service-related problems. It allows for integrated real-time management of the water system as well as remote monitoring of networks and teams. H2Porto also includes an application for the provision of information to the public, allowing, for example, customers to receive notices when the utility needs to cut the water supply to a particular area of the city.

Quantifying the benefits

After its deployment, this smart technology generated immediate results on a range of metrics, including decreasing water service interruptions and sewer collapses, improving repairs and service connections, and boosting operating gains.

The platform also helped to increase the accuracy of data produced from sensor readings to nearly 99%—allowing for better decision-making, and, according to the utility, an increase in employee and customer satisfaction.



How H2Porto improved performance



WATER SERVICE INTERRUPTION
22.9% ↓



SEWER COLLAPSES
54% ↓



BURST PIPE REPAIRS
8.3% ↑



SEWER & SERVICE CONNECTIONS
45.5% ↑



OPERATING GAINS
23% ↑

A city that leads by example

Water management is not the only area of focus for Porto's city leaders. Filipe Araujo, vice mayor of Porto, champions the city's transformation into a sustainable city. Across all urban domains, he has a vision, and the SDGs provide a framework for his plans.

"When developing our environmental, digital, and other strategies we look at our assets and measure the impact on the SDGs," he said.

The city has initiatives around clean and affordable energy, social cohesion, mobility, waste recycling, digitization, and economic diversification. The pandemic heightened the importance of other areas that were affected during the crisis, such as food security.

Araujo sees public transport as the future for Porto, and he and his team work to ensure that it is inclusive and affordable. The city heavily subsidizes the cost of public transport, for

instance, allowing children up to the age of 18 to ride for free. Part of the cost is being offset by carbon taxes.

"We are truly betting on changing the way people see public transport. We believe it will be the way people move in the city in the future," said Araujo.

With so many projects on his plate, the vice mayor sees his role as one that not only drives change within the government, but that also sets an example for—and motivates—the private sector. The city has special programs on entrepreneurship and works with a variety of incubators and start-ups. Mobilizing private investment is a key challenge ahead.

"To achieve our goals, we have to push on everything, and I would say inspire by example. The public sector has to have a strong message," said Araujo.

Porto's approach to digital innovation and the UN's SDGs

Has the skills and talent required to drive digital innovation	Has a formal process and procurement policies to identify and support the adoption of new technologies	Has an innovation hub to promote the adoption of advanced technologies across departments	Regularly monitors SDG efforts to ensure they stay on track	Has designated a department to take the lead on SDG governance and implementation	Has made the SDGs a higher priority since the pandemic
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Providing clean and efficient energy

Porto gives clean and affordable energy high priority. Over 70% of the city fleet is comprised of electric vehicles. For its public buildings and facilities, Porto uses only renewable energy, from solar, wind, or hydroelectric sources. It is also promoting clean energy in homes. The city owns 13% of the buildings in Porto, most of which are social housing stock. It has an initiative to build and support "energy communities." These are associations of residents who come together to invest in and install solar panels across their neighborhood, thereby creating efficiencies and providing less costly energy in a more sustainable way.

Similarly, the city has a project to install solar panels on schools and other buildings, which will provide necessary energy by day. Batteries will be installed to capture some of the energy that can then be distributed and used at night.

The city is also renovating some of its existing buildings and housing stock to make them more energy efficient. In the last year, it invested more than €100 million to retrofit buildings, resulting in a 40% decrease in energy consumption in these properties. All new public buildings are being built with LEED certifications to ensure they are meeting the best sustainability standards.



"Our work on sustainability is not rocket science. There is a business case. The city is a good laboratory for testing and is making a huge effort to be an example and show the private sector what is possible."

—Filipe Araujo, Vice Mayor, City of Porto

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Suzhou: On the digital fast track

Building the smart city of the future

Suzhou, a major Chinese city with 11 million inhabitants, is on its way to becoming a City 4.0. It started its journey by focusing on the SDGs and now is turning to technology to complete its transformation.

The city is already a sprinter in our SDG progress framework and is ahead of other Chinese cities in adopting best practices across many of the goals.

Suzhou regularly monitors its SDG efforts, a practice that only 22% of Chinese cities follow. It undertakes voluntary local reviews (VLR) to track SDG progress, done by only 17% of cities in the country. And it is advanced in using data, with only one other Chinese city, Chengdu, matching it in being mature in all areas of data analytics.

Suzhou is also ahead of others in implementing smart and sustainable projects. It is investing \$80 million to build a safer and more efficient, low-polluting energy center in the city. A smart transportation plan will encompass projects like smart parking, taxi information service management, and traffic information collection to alleviate congestion and reduce accidents.

A three-year action plan

Suzhou is striving to marry its progress on the SDGs with its efforts to become an innovative, digital city. At the

start of 2021, it launched a new “Three-Year Action Plan for Promoting Digital Economy and Digital Development in Suzhou City (2021-23).” The plan forms the basis for its transformation strategy.

Its objective is to accelerate the construction of digital science and technology innovation centers, digital intelligent manufacturing centers, and digital cultural tourism centers with global influence, as well as the creation of a world-class digital innovation ecosystem. The plan includes a focus on digitizing the manufacturing industry, a top priority for Suzhou, a Chinese manufacturing hub that generated [\\$14.56 billion](#) in revenue in 2019.

A push from the pandemic

Taking advantage of the fast pace of digitalization experienced following the COVID-19 outbreak, Suzhou will speed up the construction of 5G independent networks and create new green data centers. The city leaders believe that digitization is redefining productivity across the world and has become the core force driving economic and social development.

It is estimated that by 2023, the added value of the city's digital economy core industries will reach 600 billion yuan (\$92 billion), with an expected average annual growth rate of over 16%.



Partnering with technology giants

To accelerate its digital transformation and smart city strategy, Suzhou has partnered with private companies, including two Chinese technology behemoths: Huawei and Tencent.

Together with Huawei, the Suzhou Industrial Park built a new generation smart city operation management center that integrates operation analysis, incident handling, risk warning, security prevention, and control. The project utilizes Huawei's 5G, IoT, artificial intelligence, and converged communications, among other technologies. The center's aim is also to help build high-tech talent and serves as a research center, currently housing 306 high-technology companies and 384 software firms.

In January 2021, the Suzhou municipal government announced another important partnership with Tencent. The two parties signed a strategic cooperation agreement to build four innovation centers devoted to digital industry incubation, digital city technology, AI industry applications, and cultural tourism development.

Tencent will also build its first digital industry base in the Yangtze River Delta region, which covers Shanghai, and Zhejiang province. The base is expected to drive investment of 10 billion yuan

(\$1.5 billion) in related industries, while also earning 20 billion yuan annually (\$3 billion).

Planning for intelligent mobility

Tech companies are not the only ones Suzhou is allying with to build its smart future. In March 2021, it signed a memorandum of understanding with Japan's Nissan to support the city's intelligent transportation initiative. The automaker will provide technology to build intelligently connected transport networks and will explore R&D projects to develop future transport models that involve autonomous vehicles.

For Suzhou, the COVID-19 crisis...

Will accelerate the shift to online healthcare (telehealth)	Has stimulated new thinking about urban priorities & interest in programs to build the social good	Has led to environmental benefits that our city is taking steps to maintain
Will accelerate the shift to online education and change attendance at schools	Reduced 'tech-lash' in our city, i.e., citizen concerns about how technology may compromise privacy	

Partnerships prioritized by Suzhou in the next three years



REGIONAL
AGENCIES



OTHER CITIES OR
CITY NETWORKS



ACADEMIC /
RESEARCH
INSTITUTIONS



CORPORATIONS /
BUSINESSES

How Suzhou engages its citizens

Uses digital and traditional methods to communicate with citizens	Reaches out to stakeholders to demonstrate the value they could gain from a project and identify their potential roles	Ensures that disadvantaged populations, such as the handicapped and the poor, are involved in the process
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Suzhou's large investments in digital technologies

RPA & automation	Cloud	Artificial intelligence	3-D printing
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Torrance: The value of resilience and agility

How a smaller city tackled multiple disruptions

Torrance, a city of 150,000 inhabitants located in Southern California, illustrates the need for cities to be agile—and able to swiftly adopt digital technologies—at a time when disruptions can hit suddenly and cascade quickly.

On March 1st, 2020 Torrance experienced a cyber incident that had an adverse impact on city operations. Just two weeks later, Torrance declared a local state of emergency due to the coronavirus pandemic.

Going fully virtual

Faced with two major crises, city leaders scrambled to set up a virtual emergency operations center (EOC) through Slack, a cloud-based messaging platform hosted by Amazon Web Services. The city used Google Drive for all its forms and documents instead of email, as it was both safer and more efficient.

Within a week, the city had transitioned from brick and mortar, paper and pencil, to virtual operations. It was then able to connect area hospitals, the local school district, the Red Cross, Salvation Army, and business groups to the EOC for real-time information sharing. And when Torrance and Southern California experienced civil unrest—yet another disruption—a few months later, Slack allowed the city to flatten the information curve and share data, internally and confidentially, for increased awareness about the events.

The city was able to funnel live pictures of events directly into Slack where everyone involved in the management of

the response could see and better understand the situation. “There were no longer silos that could form because the departments were all dissolved,” said Jeffrey Snoddy, emergency services manager for the city.

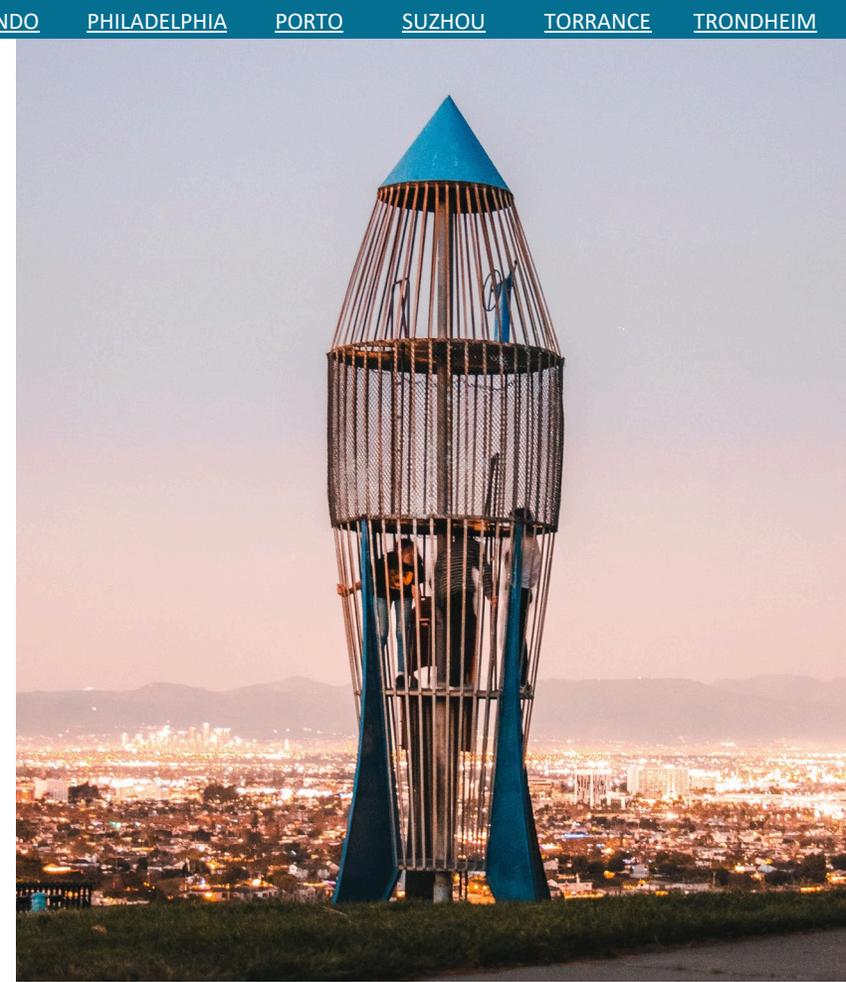
Lessons from the cyberattack

The experience was an eye-opener and the city has since developed a cybersecurity plan. Reminders are sent to staff regarding practices to shore up security, such as changing passwords regularly and connecting from home with city-issued devices only. The city also does routine self-risk assessments of its vulnerabilities.

The value of forward planning

Forging partnerships with private- and public-sector entities ahead of time was key to enabling Torrance to tackle these multiple challenges. The city’s IT department had started to assess the strength of its network and cybersecurity years ago and had established relationships with the federal government’s Cybersecurity and Infrastructure Security Agency and the Department of Homeland Security.

“They did an assessment for us. We had all their names, contacts, and recommendations, so when the cyber incident occurred, it was a simple phone call and they knew our systems,” said Snoddy. “They knew our strengths and weaknesses, and they were able to provide instant care for the city. That’s because the city was very forward-leaning.”



“Resilience and agility are a must to survive and to thrive. Governments move at a slower pace because we have fiduciary responsibility. We have oversight by our elected officials and the public. We don’t have the luxury of time. It’s not if, it’s when we’ll have another crisis and it’s all about creating a state of readiness.”

–Aram Chaparyan, City Manager, Torrance

Pandemic and post-pandemic challenges

The cyber incident that clobbered Torrance was traumatic enough, but then the pandemic took disruption to a much higher level.

Besides its terrible toll on human life, COVID-19 was a big blow to Torrance's economy. The retail and hospitality industries shut down, unemployment levels rose, and tax revenue shrank. The city lost \$26 million in revenue in the last fiscal year—or close to 15% of its general fund.

Torrance is already on a slow burn to recovery, but its reserves were depleted. Hotels, one of its more significant revenue sources, have yet to return to normal operation.

A catalyst for transformation

Yet the city's leaders remained upbeat and saw the pandemic as an opportunity to make positive changes.

“As horrible as the pandemic has been, it's given us an avenue, a window of opportunity to create new systems, such as the virtual emergency operations center. It was a wake-up call. Previously we were reliant on that traditional big room with all the monitors. We now

connect virtually, and we accomplish just as much,” said Chaparyan.

How cities will change

Looking ahead, Chaparyan foresees a range of new demands on municipal governments as urban economies and city life continue to evolve in the post-pandemic period. He notes that the reliance on sales tax as a revenue stream will diminish as more consumers shift to online purchases. The retail and office footprint in the city will also change as many people continue to work from home.

With green energy becoming more prominent in California, cities will move towards electric fleets, solar panels, and “one mile, one charge” systems.

Torrance's own one mile, one charge project, designed to facilitate the expansion of electric vehicle infrastructure so that a driver is never more than one mile from a charging station, has been successful, with 94% of the city covered.

Cities will look more holistically at issues like homelessness and the demands of an ageing population. And diversity and inclusion are square in their cross hairs.

Torrance's biggest lessons from the pandemic

Operational continuity planning and agility are critical in today's fast-changing world

Flexible and remote working can improve employee productivity and engagement

Our city needs to ensure that employees have the devices and digital access for working from home

Crisis management and emotional intelligence are vital skills for city leaders and workers

Business and government need to collaborate more closely to address today's issues



[Watch here](#)

“Sustainability, environmental stewardship, fiscal responsiveness, homelessness, affordability in housing, social equity, and injustice—those issues will carry on into the next 10 years. We have to plan and adapt to ongoing changes.”

—Aram Chaparyan, City Manager, Torrance

Trondheim: The importance of collaboration

Data-enriched partnerships to advance sustainability

Trondheim, Norway, a city named a Center of Excellence for Sustainable Development by the UN in 2019, has taken a methodical approach in utilizing partnerships together with data and metrics to drive sustainability and innovation.

Taking advantage of its proximity to the Norwegian University of Science and Technology (NTNU), the city has recruited volunteers and students interested in sustainability to conduct research and analysis and suggest smart solutions. In the city of 200,000 people, over 4,000 students work on these initiatives each year. The city also has created innovation boards that bring together university directors and deans to discuss the latest and most relevant sustainability strategies.

NTNU's artificial intelligence center, the Norwegian AI Lab, also works closely with the city. AI can provide essential data insights enabling cities to improve infrastructure, mobility, sanitation, public security, and the environment.

Partnering with other cities and citizens

Trondheim's partnerships extend to other cities within and outside of Norway, with the goal of creating a larger network of excellence. It was a leader in fostering a national network comprising 15 cities across the country, called The Sustainability Network in Norway, which has facilitated a sharing of best practices.

Outside Norway, the [+CityxChange](#) project unites 32 partners in seven European cities to create positive energy

blocks—collections of buildings that actively manage their energy consumption and energy flow between them and the wider energy system in order to achieve a positive energy balance. The long-term goal for these cities is to achieve sustainable urban ecosystems that have zero emissions and to establish a 100% renewable energy region by 2050.

“When you create a network and you have part of the solution, people are quite eager to contribute,” said Øyvind Tanum, Head of Smart City, Trondheim. “When we start a small network with a focus on data, we see where different cities have their strengths.”

Smart and sustainable cities must be very attuned to citizens, and in Trondheim residents are another important partner. The city has organized citizen panels to discuss sustainable development with experts and to highlight how local communities can contribute. Other initiatives, like [an app](#) that allows citizens to track their carbon footprint and offers personalized suggestions on how to reduce their environmental impact, have improved citizen engagement.

“We are quite systematic in how we work across institutions. With the university-city agreement, we tried to align the governance system within the city and within the university. We can give the students and scientists easier access to the city, and the problems we are having, and we can also bring new knowledge faster into the way we run the city.”

—Øyvind Tanum, Head of Smart City, Trondheim



Metrics to track performance

To supplement the qualitative information garnered from its partnerships, Trondheim heavily relies on data and metrics to track its SDG progress.

The city uses United 4 Smart Sustainable Cities (U4SSC), an open standard developed by the UN's Telecommunication Union (ITU) that includes 91 key performance indicators (KPIs), to help cities transition to smart sustainability.

The [latest report](#) on Trondheim published by the ITU in September 2020 included a verification framework for the KPIs that allowed the city to self-evaluate on 22 categories within three dimensions: the economy, the environment, and society and culture.

Where Trondheim excels

The KPIs cover everything from waste management to air and water quality, urban planning, and many other categories. For instance, Trondheim excels in ICT infrastructure, with 98% of households having internet access and wireless broadband coverage of 99.8%. Trondheim also leads on the education metric, with 100% school enrollment and 100% student ICT access—particularly essential during the COVID-19 pandemic.

The city has had more mixed results when it comes to safety, recording a long emergency service response time (14 minutes), and limited police and fire service

per capita, a performance indicator on which city leaders will now put more emphasis.

“In order to work effectively on SDGs, you need to work on different levels. Data and KPIs make this possible. This is the axis that we work around,” said Tanum. “What we do in a small municipality in Norway connects directly to what others are doing on developing voluntary local reviews, which is a more qualitative approach.”

Trondheim is also working with Norway's Statistics Bureau on a national project to create a uniform national taxonomy on SDGs, which will allow KPIs to be sorted and filtered to make them more relevant and accessible to local municipalities. This effort is especially important since, in May 2019, Norway's national government decided that the SDGs should be the foundation for all city planning.

“The SDGs are holistic on a global level, first and foremost. When you take them down to the local level, with how you measure things, how you create local ecosystems, or how you create partnerships, if you can keep the three dimensions—social, environmental, and economic—and the principles of the SDGs, then you can create useful policies, useful projects, and more useful discussions.”

—Øyvind Tanum, Head of Smart City, Trondheim

KPIs where Trondheim excels



Wireless broadband coverage
99.8%



Potable water supply
100%



Solid waste collection
100%



Student ICT access
100%

KPIs where Trondheim falls behind targets



Police service
90.81 FTE/
100,000 ppl



Poverty rate
5.70%



Emergency service response time
14 min



Physicians
87.78/
100,000 ppl

Source: U4SSC Verification Report, Trondheim, Norway, Sept 2020



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