

# Shaping smarter, safer and more livable cities

INSIGHTS & RESEARCH FROM THE  
WORLD OF SMART CITIES

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# Defining smart cities

The last two years have been full of immense global changes that have disrupted how people use public spaces, and how local governments serve the needs of their communities. New challenges have arisen, new expectations have been set – and now – new technologies are being adopted.

The movement toward “smart cities” is not, however, purely based on technology. It is simply the contemporary attempt of local governments to do that which local governments have always been charged with doing – building and maintaining infrastructure, providing essential services, maintaining public safety, and fostering economic development. The unique and defining characteristics in the “smart” movement are that cities:

- > are placing a hyper-focus on improving overall quality of life in within their community
- > have a newfound embracement of innovation
- > realize that emerging technologies provide new tools municipal leaders can use to meet their objectives
- > are doing all of this in the new era of the “data economy”

But local governments are not the only organizations changing because of the smart cities movement. Private sector organizations are embracing their role in helping municipal governments improve livability in their communities. In 2021, Axis Communications and other leading global companies sponsored an innovative research study titled Smart City Solutions for a Riskier World, conducted by thought leadership firm ESI ThoughtLab. The study examines how 167 cities across 82 countries with various income levels and population sizes have leveraged digital technologies as an enabler to achieve their goals and strive towards becoming a smarter, safer city. Results from the study are included in this magazine. To learn more, [read the full study](#).

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See the Axis smart cities video

# What makes a smart city?

There are a wide range of definitions for what makes a 'smart city'. In the Americas, Axis defines it as a community served by a local government using collaborative methods to innovate in an informed, inclusive, equitable and sustainable manner to increase operational efficiency and the likelihood of positive outcomes for residents, businesses and visitors of the community. Axis has identified three core areas that cities must monitor and control to maintain the ultimate goal of a improving a city's livability – public safety, transportation and mobility, and environmental monitoring.



## Public safety

Network video and other IoT technologies can serve as enablers and force multipliers to promote safe spaces and efficient delivery of emergency response services.



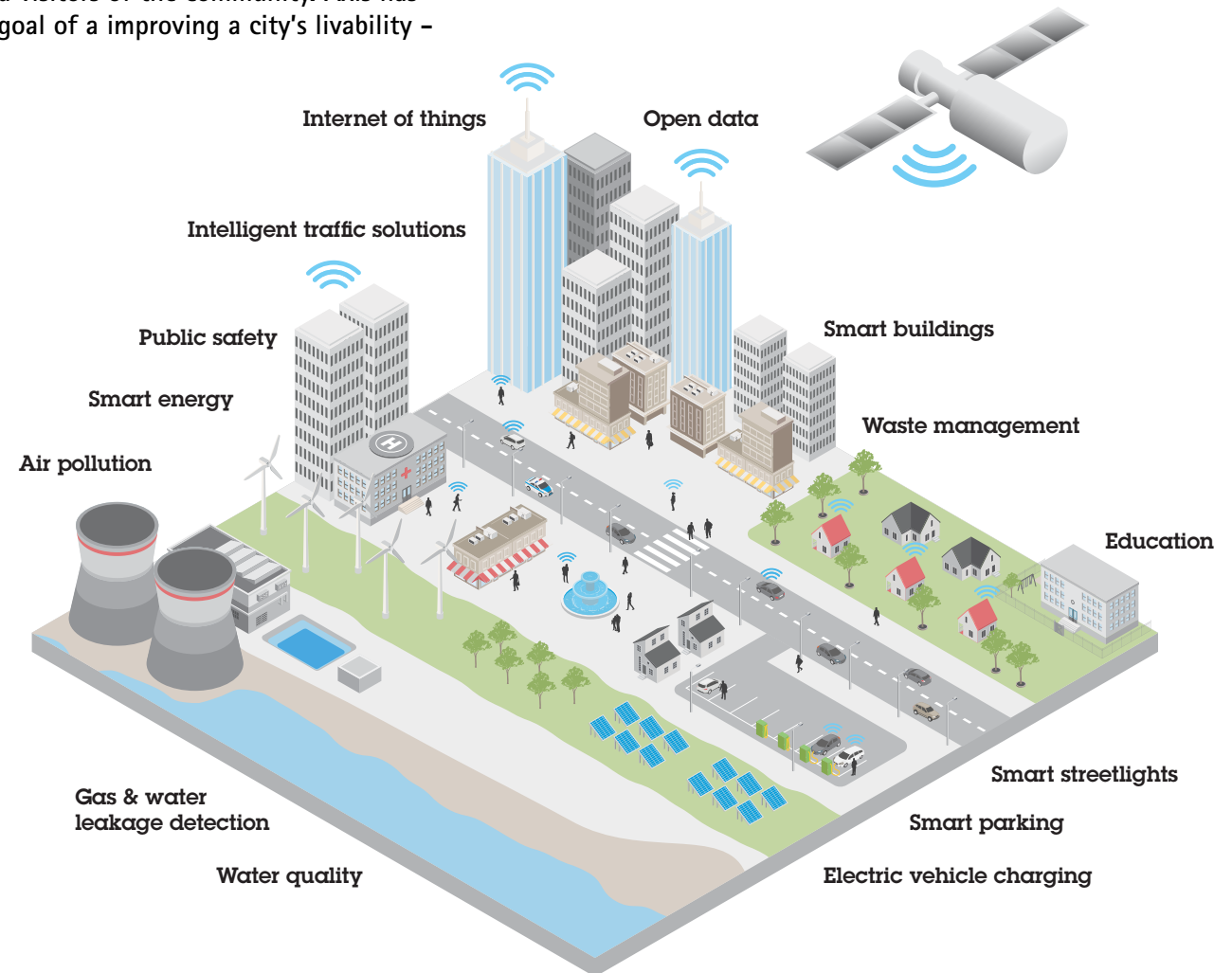
## Transportation & mobility

Cities depend on people and products being able to move safely and efficiently throughout the public right-of-way. Improved mobility is a key influencer for a city's 'livability'.



## Environmental monitoring

Sustainability and resiliency are key issues for cities. As cities grow, they place an increasing strain on the environment. Smart technology plays a role in the availability of fresh air, clean water and welcoming outdoor spaces.



*Potential factors that can contribute to a city being considered 'smart'.*

## City trends

# Popular trends in smart city programs

### The 5G game changer

Globally, we are seeing the introduction of 5G networks as an overarching trend. We anticipate that 5G will enable enterprise organizations and local governments to connect IoT devices at greater scale and to improve decision making by real-time data aggregation and analysis. 5G will enable cities to collect and transfer data at a higher speed and perform more analytics to improve efficiency. 5G will also come with enhanced cybersecurity capabilities to benefit cities.



### Urban mobility and city planning

The need to address the challenges of urban mobility is often the trigger for adopting smart city solutions. Each year we see more vehicles and people on the streets, but also new behaviors that city planners need to understand. Traditional transport systems such as buses, trains and taxis have faced competition in recent years with new mobility options from Uber and Lyft, and micro-mobility services in the form of bicycles and scooters. Despite their popularity, cities are learning that inner-city congestion is getting worse, not shrinking. There will be a continued trend towards car-free city centers and fee-based zones, which the private sector is already reacting to. Companies like Uber are even considering such radical innovations like flying cars and eVTOLs to avoid the risk of being banned.

### Sustainability in focus

Although climate change is not necessarily a major concern for city dwellers, for planners it is one of the biggest challenges facing cities today. Extreme weather, rising water levels and diminishing resources are becoming an increasingly visible threat to urban areas. Most cities were planned in a time before climate awareness and are therefore fundamentally ill-equipped to face climate change. Smart cities are adopting greener goals to reduce their carbon footprint and environmental impact and investing in technology to monitor the threat and impact of extreme weather. Smart solutions like air quality monitoring, energy optimization and electricity, water and waste tracking are on the rise as cities strive to meet the challenges of climate change. Instead of IoT solutions, cities will look towards the 'Green Internet of Things' to facilitate environmental conservation and surveillance.



# Deeper, clearer insights within the 5G revolution

The 5G roll-out is creating interest all over the world and is expected to have enormous significance for cities.

5G networks have the potential to improve scalability and enable more use cases of network video IoT solutions in cities. Gartner predicts outdoor surveillance cameras will be the largest market for 5G Internet of Things solutions in the near future. Municipal agencies and departments will be able to optimize traffic flow, reduce road incidents, increase public safety and promote overall community resilience through intelligent use of cameras as notification and data aggregation sensors connected to 5G networks. Currently, most video surveillance systems are connected physically. 5G will make it possible to position cameras in locations where wireline infrastructure does not exist. We are already seeing this trend with 4G LTE routers for temporary deployable solutions.

Have you considered how 5G will affect cybersecurity? Even if the sheer amount of data transmitted over 5G networks and the inevitable increase in the number of connected sensors offer a tempting target for skilled cyber criminals, 5G will provide a more stable and secure network with added capabilities to strengthen cybersecurity.

**5G enables IoT in smart cities.**



# Edge in name, edge in nature

More and more smart cities are adopting edge-based solutions because of their advantages when combined with deep learning. Edge computing empowers cities to generate and analyze data on devices; deep learning lets them harness the data with extreme precision, speed, reliability and accuracy. ESI ThoughtLab research indicates that 66% of cities are currently investing in AI and 80% will be investing over the next three years.

## Lower bandwidth consumption

Cloud-based training and inference models require devices to transmit huge amounts of raw data to the cloud. This massive flow of data stresses network infrastructure and bandwidth resources. With IoT sensors that feature edge based deep learning, solutions can be architected to only transmit analyzed metadata, therein only requiring a small fraction of available bandwidth.

## Reduced latency

Some use cases - traffic incident management for example - require time accuracy at the millisecond resolution level. Latency can not only make the difference in capturing or missing the incident, but as Connected Autonomous Vehicles emerge, low-latency edge applications could lead to incident intervention and avoidance.

## Increased resilience

As cloud- or server-based analysis relies heavily on wireless networks, any disruption in coverage can significantly impact the results. With edge-based deep learning, all computing happens on the device itself and is less susceptible to the impact of intermittent outages in network coverage.

## Privacy compliance

Datasets of personally identifiable information (PII) such as license plate numbers and facial images are increasingly protected by privacy legislation. Minimizing the amount of personal data transferred to the cloud can also help ensure privacy compliance.

## Cost savings

Transmitting analyzed metadata rather than large amounts of raw unstructured data such as video eliminates the need for additional storage devices or expensive cloud-based storage fees. In addition to saving on hardware and storage costs, the system consumes far less power - minimizing both costs and environmental impact.

## The hybrid future

Despite their many benefits, edge-based solutions are not predicted to replace cloud or server-based computing. For some municipalities, transportation departments, and law enforcements agencies, combining the two technologies yields the best results. Server-based video analytics are ideal for post-event investigations and can help to provide actionable insights for data-driven safety and operational decision-making, while AI-based edge analytics activate real-time alerting efficiency.

The new generation of AI-based edge analytics is becoming a realistic, affordable option for smart cities. This opens the door to the democratization of accurate, powerful and usable real-time video analytics.

Deep Learning Processing Units (DLPUs) are continuing to improve and are becoming more affordable, and deep neural networks (DNNs) are further optimizing performance for DLPUs. This can only mean more advanced real-time AI-based video analysis applications delivered on the edge. We can also expect hybrid solutions that combine the best of both worlds to enable full real-time, AI-based video analytic applications.



## AXIS Q1615-E Mk III Network Camera with deep learning

The world's first outdoor-ready network camera with an intelligent i-CS lens. It delivers superior image quality in footage of fast-moving objects under even the most demanding lighting conditions. A choice of three scene profiles lets you customize each AXIS Q1615-LE Mk III in your surveillance solution to meet the requirements of specific scenes. AXIS Q1615-LE Mk III is perfect for outdoor surveillance at airports and train stations or for city surveillance.



[See the AXIS Q1615-LE Mk III video here](#)

# Smart poles - the optimal smart city enabler

Across the globe, the smart city concept is maturing. Authorities are finding ways to collaborate by sharing data, technology and resources to work more efficiently. At the same time, we are witnessing a rapid development when it comes to "smart pole" projects in cities all over the world.

**A network camera on a smart pole can provide a lot of valuable data on its own, such as traditional video surveillance or traffic statistics for city planning. But integrating network cameras with other IoT devices and sensors massively boosts a smart pole's potential.**

## Defining a smart pole

For many years, streetlight manufacturers have served as the drivers for the development of smart poles. Contemporary smart poles, however, are more than intelligent lighting solutions – in fact, lighting is just one of many options that can be integrated in a smart pole.

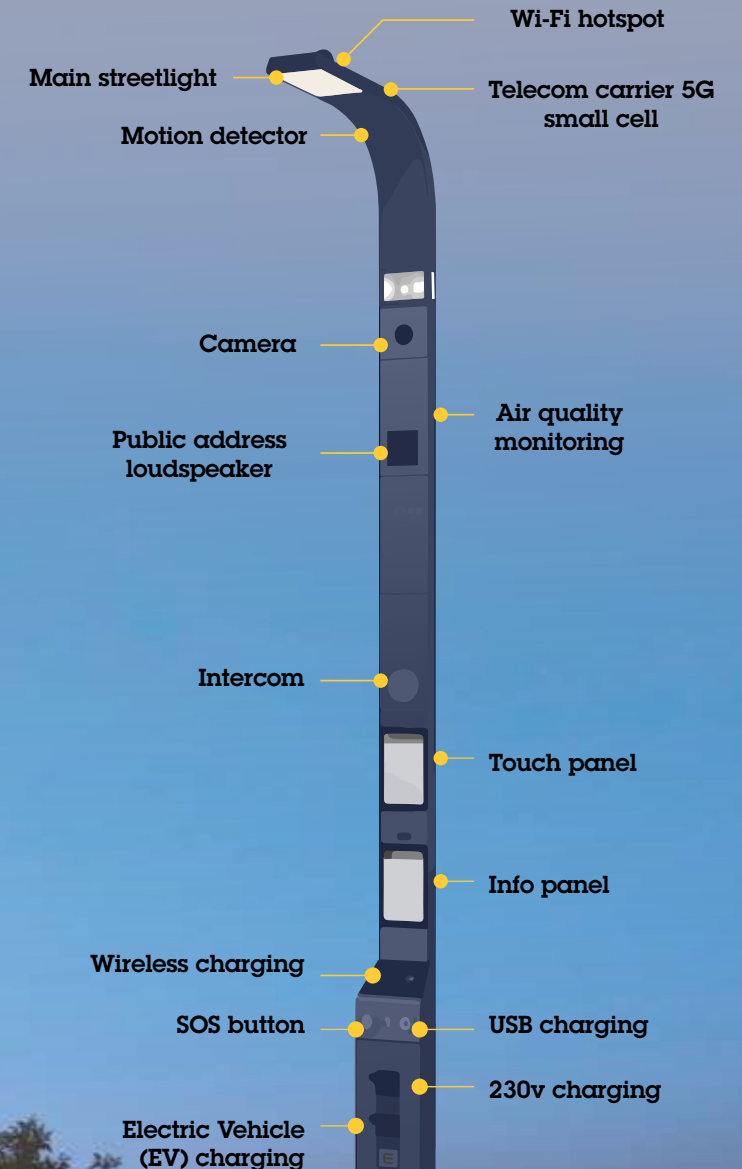
Today's smart poles can be seen as small-footprint platforms capable of hosting an array of IoT sensors, plus the connectivity and charging tools essential to smart cities.

No matter what technologies are integrated in a smart pole, its primary purpose is to combine sensors and technologies to see, hear, and experience the physical world, then turn that information into digital insights that can be used to make decisions or launch a response across the city.

## The result?

Cities that work smarter, faster, and more collaboratively across departments.

## The anatomy of a smart pole



## Public safety

# IoT use cases that promote safe public spaces

Technologies to help you work more efficiently with citizen safety, emergency situations, and incident management.



**Network cameras** can be fixed at intersections, storefronts or busy thoroughfares.

They can also move where they are needed: integrated into the lightbar on a patrol car or the uniform of a police officer, or deployed as a LTE- or 5G-connected surveillance solution for remote or temporary locations away from traditional networks.

**Different cameras offer unique perspectives.**

By matching the technology (for example, field of view, audio vs. visual, image resolution capabilities) to the area and integrating a variety of tools, law enforcement can:

- Improve situational awareness
- Support responding officers with real-time information
- Provide transparency to increase safety and build trust in communities

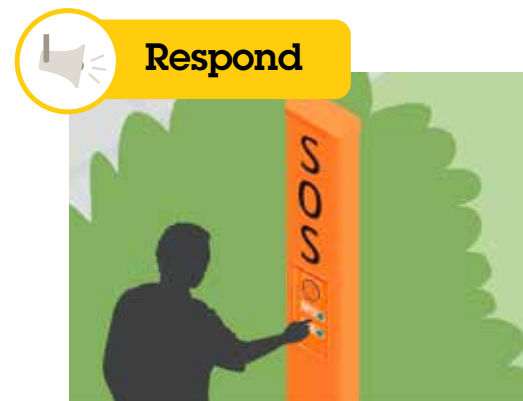


**License plate cameras** can identify the presence of a reported stolen vehicle or locate a vehicle of interest during a missing persons search.

**Network horn speakers** in highly trafficked or restricted areas can be used to deter potential vandals and loiterers with automated or manned responses.

**Body worn cameras**, when overtly worn and activated, can serve as a reminder to civilian and officer that interactions are recorded therein encouraging good behavior.

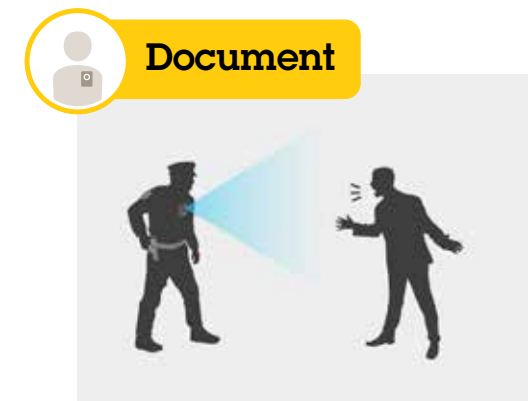
**Edge-based analytics.** Accurate object classifications enabled by deep learning on the edge assists in identifying when unauthorized people or vehicles enter a restricted area or approach a critical infrastructure asset.



Including audio devices and systems into IoT architecture can yield multiple benefits for cities.

Intercom and emergency call devices can, with the touch of a single button, connect a person in distress with the local Public Safety Answering Point (PSAP) for exact location and communication. A call can also automate commands to nearby cameras allowing the PSAP operator to see a visual representation of the callers environment, and data can be pushed to first responders.

Loudspeakers can also be used to broadcast messages for crowd control during unique circumstances that draw large crowds such as sports and entertainment events, cultural festivals and parades. And when inclement weather strikes, the system can broadcast messages to evacuate or to shelter in place.



**Body worn cameras** capture and preserve up-close interactions with the public, providing visual and audio data other network solutions may not.

By pairing audible and visual data from wearable cameras, law enforcement officials can build a more complete, accurate picture of difficult-to-assess interactions and supply evidence for situations in which there are no witnesses.

Many modern high resolutions network cameras are capable of providing clear images even in challenging light and weather conditions. They can be counted on to deliver documentation when it matters.



# Body worn solutions for law enforcement

## Making smart city technology personal

As cities grow, innovative solutions are needed to address the challenges of urbanization. The widespread adoption of body worn cameras is one example. By providing transparency and fostering trust, body worn cameras are a valuable tool in making communities safer and more livable. Durable designs and leading technology capture forensic-quality video and audio evidence in all kinds of challenging situations – data that's invaluable for investigations, courtrooms, and training situations.

### Public safety and security is critical.

In the ESI ThoughtLab study, cities were asked "what are the most effective steps that your city is taking to improve public safety and security?". The top answers from the research reveals that body worn can have an impact on all:

- Work with neighborhood groups to keep citizens safe
- Share data on crime with law enforcement
- Build a culture of trust, citizen respect and safety
- Adopt disaster risk reduction, preparedness and resilience
- Promote citizen safety through urban planning and design

Stakeholders evaluating and considering body worn camera offerings for their law enforcement officers should consider aspects such as:

- Size and weight of the device to ensure it does not impede an officers range of motion
- Versatile mounting options to adapt to all types of uniforms and clothing
- The ability of devices to "self-assign" when removing from the dock so an agency can save money on hardware
- Ease of use including start-and-stop of recording and optional pre-activation buffer
- Battery life to ensure the device serves officers working expanded shifts and the capability of in-field charging
- Overall system architecture including scalability, encryption for data security, and speed/reliability of off-load
- Total cost of ownership including any required data hosting platform and storage costs

## From the leader in network video



### Open technology for maximum flexibility

Axis body worn systems are built on open technology so you decide what's best for you – integration with your existing system and installing a completely new system are both easy.



### Global partner network for easy integration

Body worn systems are distributed and integrated through an extensive network of Axis partners, which means support for building a customized system is nearby – from advice, to integration, to training, to system upgrades down the line.

## Hear directly from law enforcement agencies

- The Auburn, New Hampshire Police Department is capturing incidents and citizen interactions by [securing a chronicle of corroborating evidence](#).
- Learn how the New Windsor Police Department in New York is working within their community to [build trust through transparency](#).

Body worn cameras are also beneficial outside of law enforcement as well and can be a valuable part of the toolkits for first responders, as well as those serving in health, education, and public transportation roles.



Axis body worn cameras



## Public safety

### License plate recognition

Combined with parking management systems, LPR technology can help drivers access and pay for parking faster, which will improve traffic flow and efficiency in the area.

# A smart solution for many urban challenges

Experts estimate that there will be an estimated 2 billion vehicles on the road by 2030. Managing these vehicles is a major challenge, especially in densely populated areas and bustling business districts, where city planners need to meet the demands of a mobile – and growing – population. License plate recognition (LPR) represents an ideal – and relatively inexpensive – road toward this goal of smarter mobility and traffic management. LPR can also yield public safety benefits. Here are several applications where license plate recognition can be used.



#### Urban city planning

City planners can use LPR technology to analyze traffic and vehicle statistics.

- Count and classify vehicles that enter/exit the city
- Monitor traffic flow like journey times, congestions, and average speed
- Analyze the environmental impact from vehicles in different areas



#### Urban traffic management

Traffic authorities can use LPR technology for real-time traffic management.

- Detect and manage congestion with lane control
- Measure and manage average speed control
- Detect and monitor vehicles with dangerous goods



#### Urban traffic investigations

Law enforcement can use LPR technology for real-time and forensic search.

- Search for missing/wanted vehicles
- Search for vehicle information - make, model, color



#### Access control

City and traffic authorities can use LPR technology to manage a variety of access control uses.

- Toll and border control
- Restricted access for law enforcement and emergency services
- Access control for parking, residential and historic areas
- Emission control – deny access for high polluting vehicles and allow access for electric vehicles

# Sustainability for cities

We all have a responsibility and role to play in building a more sustainable future. Cities have a disproportionate impact on the environment, and therefore have a significant role to play in meeting sustainability goals. 68% of the world's population is expected to be living in a city by 2050.

External circumstances around the world have accelerated the need for cities to adopt innovative solutions to achieve their social, environmental, and economic goals. It has also affected the way people want to live and what they value. A desire for cleanliness, open spaces and green areas have disrupted traditional city planning. Yet priorities and solutions vary depending on the needs and challenges of each city and how effective they are at using digital solutions and technologies to achieve their goals.

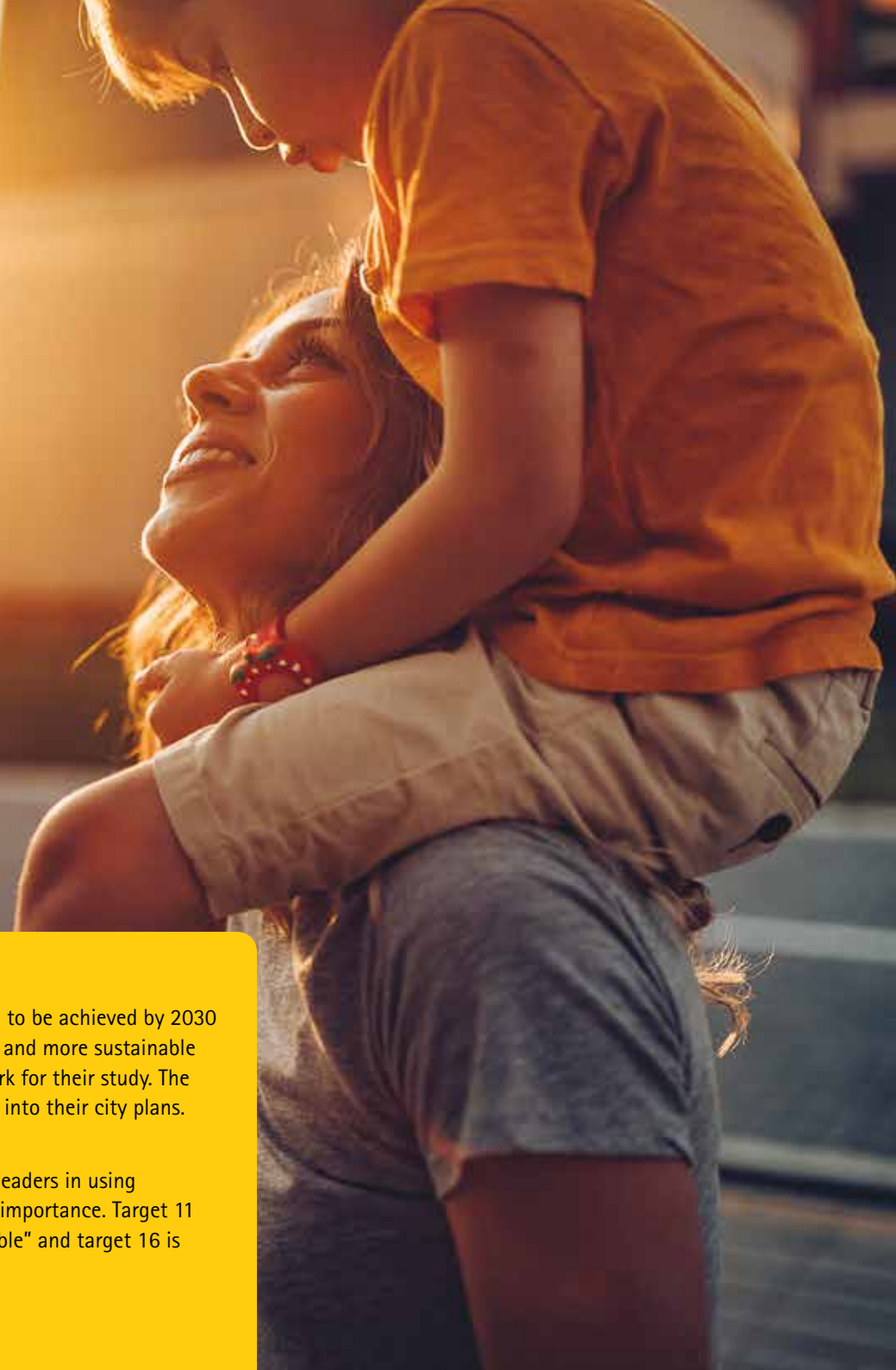
While the challenges are significant, there's evidence that city leaders are taking their responsibility seriously. To find the right solutions, city leaders have to look at how well they leverage digital technologies and data, which leads to the question of how network video and other IoT sensor technologies can help cities achieve their sustainability goals.

And cities have the unique ability to be force multipliers of sustainability goals by holding the vendors and partners they do business with to a reasonable standard. Are you asking the organizations - often global organizations - that your city does business with to share their annual review and sustainability report to ensure their values align within reasonable tolerances to the values of your community?

## A clear link between technology data and sustainability

In 2015, the United Nations created the 17 Sustainable Development Goals (SDGs). They are designed to be achieved by 2030 and are an important framework for cities. The SDGs are meant to be "a blueprint to achieve a better and more sustainable future for all". ESI ThoughtLab uses the 17 Sustainable Development Goals as the analytical framework for their study. The research shows that almost 8 out of 10 cities (80%) have fully incorporated the UN's SDG framework into their city plans.

The ESI ThoughtLab research found that the cities making best progress towards the SDGs were also leaders in using technology, data, and partnerships to achieve their SDGs. SDG Targets 11 and 16 will be of particular importance. Target 11 is specifically focused on "making cities and human settlements inclusive, safe, resilient and sustainable" and target 16 is focused on "peace, justice and strong institutions" to keep cities safe.



# Video technology can help cities achieve their sustainability goals

Axis supports cities in becoming more sustainable and in reaching their sustainability targets with use cases addressing the majority of the SDGs.

## Sustainable mobility and transportation

Enabling citizens to move around safely and efficiently is a fundamental part of a city's livability and is covered across several SDGs and targets, especially those related to cities and human settlements, infrastructure, economic growth, energy, and health. A subpoint to target 11 mentions: "Affordable and sustainable public transport systems", which means that citizens should be able to move around freely and easily.

Video surveillance helps ensure the safety of citizens and personnel on public transportation but it can also facilitate better traffic flow and traffic safety, all of which lowers the number of traffic-related injuries and reduces damage. Increasingly, data from environmental sensors and video surveillance cameras are used as a proactive tool in planning and managing transportation infrastructure to reduce its environmental impact.

To learn more about how Axis can help you reach your sustainability goals, visit [www.axis.com/sustainability](http://www.axis.com/sustainability)

## Environmental factors

Monitoring of environmental factors is essential for smart city sustainability and for ensuring the SDG 3: "Good Health and Well-Being". Highly sensitive environmental sensors – such as those measuring air quality – used alongside video surveillance and connected technology such as audio, give city leaders early warning of issues, visual verification and the ability to take correct actions. It also gives them time to prepare for severe weather as they can use pre-recorded warnings to keep people safe.

Video and related metadata can be analyzed and used to plan long-term initiatives to reduce the impact of pollution and noise, both of which are closely linked to serious issues. This relates to another subpoint in Target 11, which states: "By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management". Video surveillance can also show that waste is being collected and managed in accordance with the SDGs, as well as monitoring for and deterring illegal dumping.

## Public safety in cities

One of the fundamental roles that video surveillance plays across the whole world, is "making people feel safe". This is also a goal for every city, and is covered by the SDGs under Target 11: "Provide access to safe and inclusive green and public spaces". However, it remains a sad truth that the population density in urban centers means that they are places that can both attract criminal activity and where incidents and emergencies can quickly become a serious risk to large numbers of people. SDG 16, "Peace, Justice and Strong Institutions" covers a number of relevant areas in detail with specific targets focused on reducing violence and combating organized crime.

Intelligent video analytics can monitor multiple video streams, spotting anomalies, unusual patterns, specific objects or suspicious behavior and quickly bring an operator's attention to the scene. Intervention can then be initiated through emergency services, or via audio speakers on site, either warning criminals that they're being watched, or offering assistance, advice, and guidance to people at the scene. Such rapid reaction prevent some events from escalating to potentially criminal or harmful activity, evacuate a specific area, or provide direct assistance before emergency services arrive.



# Smarter, more livable cities

In the ESI ThoughtLab research results, cities who took the survey were categorized into several framework stages. One of those includes the three stages of smart city progress. In this classification, ESI ThoughtLab looked at the ways that cities are making progress using 'digital solutions and technologies to achieve their social, environmental and economic goals'.

The three stages of the smart city progress from the report are identified below:

## Beginner 29%

Starting to use technology and data to achieve goals.

## Intermediate 49%

Making progress on using technology and data across the urban domains.

## Leader 22%

Advanced in the use of technology and data across the urban domains.

With innovative technology and extensive partner network, Axis can help you face today's complex urban challenges, such as public safety, urban mobility and environmental monitoring. With this groundwork, cities have the ability to drive remarkable change and become a leader in the smart city progress, enabling you to create a smarter, more livable city.

# About Axis Communications

Axis enables a smarter and safer world by creating network solutions that provide insights for improving security and new ways of doing business. As the industry leader in network video, Axis offers products and services for video surveillance and analytics, access control, intercom and audio systems. Axis has more than 3,800 dedicated employees in over 50 countries and collaborates with partners worldwide to deliver customer solutions. Axis was founded in 1984 and has its headquarters in Lund, Sweden.

For more information about Axis, please visit our website [www.axis.com](http://www.axis.com)