GSMA

IoT and Essential Utility Services:
India market case study

GSMA

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This initiative has been funded by UK Aid from the UK Government and is supported by the GSMA and its members.

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Utility services such as energy, water, sanitation, waste management and transport are essential to life. The Digital Utilities programme enables access to affordable, reliable, safe and sustainable urban utility services for low-income populations through digital solutions and innovative partnerships. In doing so, we also seek to support cities in low- and middle-income countries in their transition to a low carbon, climate-resilient future.

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Introduction

GSMA Intelligence forecasts that smart utilities Internet of Things (IoT) connections will total 3.5 billion globally by 2030, up from 1.7 billion in 2021. Growth will be particularly strong in low- and middle-income countries (LMICs), where many companies are still in the early stages of their IoT journeys. In Sub-Saharan Africa, for example, smart utilities connections will increase almost six-fold between 2021 and 2030, reaching 152 million. By 2030, utility solutions will account for nearly 30% of IoT connections in the region.

Mobile-enabled digital solutions are uniquely placed to address the challenges facing utility sectors, including water shortages, lack of sanitation, unreliable power and insufficient waste management. IoT is pivotal to many digital solutions, often working in tandem with other mobile technologies.

This case study is one of five detailed market case studies examining IoT deployments in 17 key use cases across five verticals: energy, water, transport, sanitation and waste management. It also examines broader market conditions and enablers of IoT solutions.

This case study is a stand-alone document, but can also be read alongside two recent GSMA reports on IoT deployments:

— *IoT for Development: Use Cases Delivering Impact* – this report provides a more detailed discussion of the solution architecture for IoT, data on the connectivity options in 62 LMIC markets in Sub-Saharan Africa and South and Southeast Asia, and discusses use cases across the climate, health, agriculture and humanitarian sectors.

— *IoT and Essential Utility Services: Opportunities in Emerging Markets* – this report summarises the IoT opportunity across the the utilities sectors and draws together lessons from the five market case studies.

The 17 IoT use cases we examined are in no way an exhaustive list, but were selected as the use cases most likely to be implemented in the five markets we reviewed, and have significant benefits for utility providers and customers. Annex 1 provides additional details on the use cases and key benefits that can be expected from IoT deployments.

This case study begins by discussing the national context and trends across use cases before turning to discuss the sector verticals and key IoT deployments identified within them.

Market context

Figure 1

Key data on India's mobile market

5G Not Launched
4G 99%
3G 90%
2G 99%

India	
Mobile penetration[a]	63%
Mobile internet penetration[b]	48%
Smartphone adoption[c]	76%
Made or received a digital payment	35%
GSMA Mobile Connectivity Index (MCI) score (out of 100)[d]	61
LPWANs:	NB-IoT, Sigfox, LoRaWAN

Notes on indicators: a) defined as unique mobile subscribers as a percentage of the population, b) defined as unique mobile internet subscribers as a percentage of the population, c) percentage of connections, d) the GSMA Mobile Connectivity Index measures the performance of 170 countries – representing 99% of the global population – against key enablers of mobile internet adoption: infrastructure, affordability, consumer readiness and content and services. More details can be found at: mobileconnectivityindex.com.

Source: GSMA Intelligence for all indicators except "made or received digital payment", which is from the World Bank's Findex Database 2021. Data accurate as of December 2022

In 2015, the Indian government introduced the Digital India programme, which aims to transform the country into a digital society and economy. Mobile technologies, including IoT, are at the heart of efforts to realise the three areas of the Digital India vision: digital infrastructure as a core utility for every citizen, digital governance and services on-demand and the digital empowerment of citizens.

As part of Digital India, the Center of Excellence for IoT (CoE-IoT) was created in Bangalore to kick-start India's IoT ecosystem. The aim of the Center of Excellence is to bring together start-ups, enterprises and the government to solve real-world challenges using IoT and other frontier technologies, such as AI, big data, machine learning and augmented reality/virtual reality (AR/VR). Along with a co-working space, there is an innovation lab supporting hardware manufacturers with facilities, including a vector signal generator, 500 MHz oscilloscope and development kits. The Digital India initiative also supports IoT manufacturers through the Production Linked Incentive Scheme, which has recently been expanded to include smart meters.[1] Beyond Digital India, the Indian government has allocated Rs 1 lakh crore ($12 billion)[2] to the Smart Cities Mission to drive additional IoT deployments.

1. Taxmann. (2022). "Customs proposals – A catalyst to Make in India and PLI schemes".
2. Business Standard. (9 July 2015). "Cabinet nod To Rs 1 lakh cr for urban renewal, 100 smart cities to take off".

In addition to policy support from the government, India's IoT ecosystem also benefits from a rapidly maturing mobile market. It has the highest mobile internet penetration (48%) among the case study countries, driven by the rapid expansion of 4G networks and growing affordability of mobile internet services. Mobile operators in India have also invested in deploying NB-IoT networks to support IoT services. For example, Reliance Jio reports 95% NB-IoT population coverage, making it one of the largest NB-IoT networks in the world. This is spurring developments in the rest of the IoT ecosystem. India is home to a growing number of device manufacturers, system integrators and start-ups, with IoT deployments cropping up across the utilities sector.

Our research shows evidence of IoT deployments across India's utility sectors. While the maturity of IoT applications varies, the combination of a thriving local IoT ecosystem and strong political support should ensure deployments continue to scale in each of the focus areas. In some cases, such as smart toilets, driving user adoption will also require public awareness initiatives to educate people on the benefits of handwashing and toilet usage.

Some regions in India are ahead of others in IoT deployment. The pace and level of development often depend on the priorities of the local government driving smart city implementations, as well as regional differences in IoT ecosystem development. Currently, most IoT devices cater to 2G or 4G networks, but LPWA technologies and 5G can be expected to take on a bigger role as network roll-outs continue.

Figure 2

Heatmap of IoT in India's utilities sectors

	Focus areas			
Energy	Smart metering	Smart grids	Microgrids	PAYG cooking
Water	Smart metering	Water ATMs	Water treatment	Supply network monitoring
Sanitation	Wastewater monitoring	Smart toilets	Pit fill level monitoring	-
Waste management	Smart bins	Smart recycling	-	-
Transport	Smart public transport systems	Electric vehicles (EVs)	Asset tracking	Drones for deliveries

NASCENT — INTERMEDIATE — ADVANCED

Factors assessed	Number of deployments, suitability of connectivity options, hardware avaibility, number of solutions provider, funding requirements

Source: Authors' assessment based on market research and interviews with key actors

Energy

IoT is central to the Indian government's strategy to reduce transmission and distribution losses. This includes a nationwide roll-out of smart meters led by the government. A key requirement is that all meters procured under the initiative must be manufactured locally, which is defined as 50% of value addition occurring in India. As of March 2022, 15 million meters had been procured, with another 235 million required by 2025 to meet government targets.[3] Producing this quantity of meters helps local manufacturers to compete on price with large-scale international meter companies. For example, Airtel highlights that local manufacturers sell smart meters for Rs 6,000–7,500 (around $70–$90).[4] The smart meter roll-out should help to stabilise electricity supply, along with other efforts to create a smarter national grid.[5]

There is also growing interest in solar-based solutions that leverage IoT devices to remotely monitor microgrids, particularly in rural areas. Much of the investment has come from donors and corporate social responsibility (CSR) initiatives of large organisations, such as Tata Power and The Rockefeller Foundation's Smart Power for Rural Development programme, which aims to become the world's largest renewable microgrid developer.[6] Local start-ups have developed similar propositions. However, a lack of policy direction on how microgrids can co-exist with the national grid has created challenges in scaling these businesses.[7]

IoT is supporting rural energy access in other ways, such as IoT-enabled inverters for solar home systems (SHS). This is helping to meet customer demand for information on how their solar products are performing even when they are away from home.[8] MNOs play a key role in supporting many of these solutions by providing IoT connectivity and platforms. This highlights the potential for mobile operators to be end-to-end IoT solution providers.[9] Compared with SHS, there is less demand for other IoT-enabled home products, such as pay-as-you-go (PAYG) electric stoves or liquefied petroleum gas (LPG) cylinders. One reason for this is the high proportion of homes in India that have access to subsidised LPG connections through the Pradhan Mantri Ujjwala Yojana scheme, which is creating demand for smart gas meters.

Spotlight 1

The role of mobile operators in India's smart meter roll-out

Mobile operators are supporting India's smart meter roll-out. For instance, Vi has partnered with IoT platform provider Trilliant to deploy more than 1.4 million smart meters for seven utilities in Haryana and Uttar Pradesh states. Most of the meters leverage Vodafone's 2G network. Reliance Jio is also playing an active role, offering NB-IoT connectivity and their cloud services for smart metering applications. The difference in network choice reflects Jio's position as a 4G-only operator (i.e. they do not offer 2G or 3G). This has led them to embark on an extensive NB-IoT roll-out covering around 95% of the population. Low-range wide area network (LoRaWAN) operators are less active in smart energy meters due to their limited coverage, but have participated in small-scale gas meter pilots.[10]

3. Spencer Jones, J. (1 March 2022). "EDF reaches 500,000 smart meter milestone in India". *Smart Energy International*.
4. Airtel. (14 June 2022). "Smart Metering – A Digital Approach of Connected Devices".
5. See, for example: National Smart Grid Mission.
6. The Rockefeller Foundation. (4 November 2019) "Tata Power and The Rockefeller Foundation Announce Breakthrough Enterprise to Empower Millions of Indians with Renewable Microgrid Electricity".
7. Ganguly, S. (7 July 2021). "How Jaipur-based Gram Power is using smart grid technology to help utilities reduce losses". *YourStory*.
8. Tata Tele Business Services. (n.d.). "Luminous enables efficient energy management with IoT".
9. VI Business. (n.d.). "Enabling Simpa to track energy consumption".
10. Estopace, E. (9 March 2019). "India's gas distribution firm pilots prepaid smart gas meters". *FutureIoT*.

Water

India is the leader of the case study countries when it comes to deploying IoT solutions in the water sector. The Ministry of Jal Shakti, the government department that oversees water resources, has conducted a series of trials to show how IoT devices can monitor water supply systems in villages. Developments in the national water monitoring system, the India-WRIS (see Spotlight 2) also include IoT deployments.[11]

IoT technologies are prevalent in other parts of India's water sector, too. Multiple water treatment and quality management solutions are available in the market, such as end-to-end solutions from Biz4Solutions and RefillBot, while mobile-enabled water ATMs are deployed by companies such as Drinkwell, Janajal and Sarvajal. There is also a drive to deploy smart meters. Municipal water corporations in Chandigarh, New Delhi, Hyderabad, Pune and others have all launched large-scale smart water meter programmes. However, as in other countries, the business case for smart water meter deployments is challenging given the price of water. The water sector therefore remains behind the energy sector when it comes to smart meter roll-outs in India.

The emphasis on using IoT technologies to improve India's water system reflects the gravity of the country's situation. India has around 17% of the world's population but only 4% of the world's freshwater resources, making it one of the world's most water-stressed countries.[16] It is therefore imperative that water resources are managed efficiently. At the same time, the country boasts a vibrant IoT ecosystem that plays an active role in supporting the use of new technologies in the water sector. Most of these solutions leverage GSM connectivity, but there is also a growing market for LoRaWAN-based solutions, such as those deployed by WEGOT.

Spotlight 2
Groundwater monitoring in India

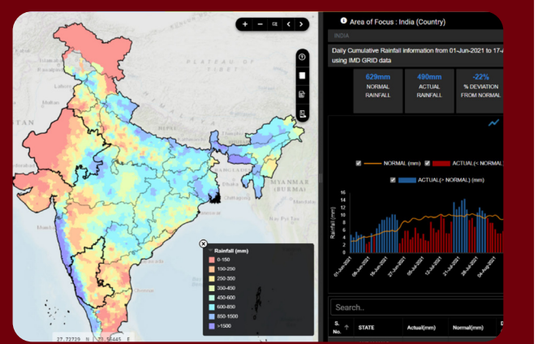
Visibility into water resources is crucial when it comes to using water efficiently. However, when multiple stakeholders use, track and manage water, it can be difficult to gain the insights necessary to improve decision-making. The Ministry of Jal Shakti is working with IoT solution provider Vassar Labs to devise a solution that would integrate data from various sources in one centralised, web-based platform.

Around 6,000 sensors will be installed across India to gather data on lakes, reservoirs and rivers, and another 1,600 sensors will track underground water.[12] These will provide information on rainfall, water levels, water quality and other parameters, and will be transferred by mobile and satellite networks to the central platform.[13]

With the support of analytics software, officials and other entities can make decisions about water management based on real-time data.
The solution has helped improve the execution of water conservation planning at the national level, and is a valuable tool for tackling India's water challenges.

Other pilots and testing for groundwater monitoring are also ongoing. For example, Tata Community Initiatives Trust, Tata Trusts and the Jal Jeevan Mission (JJM) recently completed pilot projects to monitor the water supply systems of remote villages in five states (Uttarakhand, Rajasthan, Gujarat, Maharashtra and Himachal Pradesh). Several types of sensors were deployed, including flow meters, groundwater level sensors, chlorine analysers, pressure sensors and pump controllers. Cellular connectivity transmitted data from the sensors to an IoT platform, which could be used to identify distribution issues such as outages, leakages and low pressure. It also alerted municipalities to fast-depleting groundwater levels and the need to strengthen boreholes in some villages.[14]

Figure 3, National water monitoring system (India-WRIS)



Source: Vassar Labs[15]

11. Economic Times. (18 April 2017). "India signs $175-million loan pact with World Bank to improve water management".
12. Gupta, P. (12 August 2022). "High and low-tech ways to tackle India's water crisis". *BBC News*.
13. Ministry of Water Resources, River Development and Ganga Rejuvenation. Government of India. (May 2017). *An Introduction to Real-time Hydrological Information System*.
14. Ministry of Jal Shakti. (31 March 2021). "Jal Jeevan Mission deploys first-of-its-kind sensor-based IoT devices to monitor rural drinking water supply systems". Press release.
15. For more information, see: https://www.vassarlabs.com/cms/portfolio-item/india-wris/

Sanitation

The Swachh Bharat Mission (SBM) aims to accelerate efforts to achieve universal sanitation coverage in India. The government initiative has received unprecedented political support and mobilised $25 billion from the government, private sector and civil society. This is driving innovation across the sanitation value chain with IoT technologies used in several deployments, from smart toilets to septic tank maintenance. For example, local governments in Maharashtra use IoT-based platforms like SaniTab and SaniTrack to monitor waste emptying and transportation.[17] Use of these platforms is likely to increase as the national government continues to stress the importance of regular desludging under their sanitation policy.

The use of IoT in sewage management is at a more nascent stage. Most initial deployments have been small-scale trials driven by municipalities seeking to upgrade existing manual monitoring systems. For example, in 2021, Haryana State Commission for Safai Karmachari and the Municipal Corporation of Gurugram installed a sensor-based sewer monitoring system at four manholes in the city. The system detects discharge and sends alert messages to workers when water reaches a critical level. Similar solutions have been deployed in other cities. These tend to work over 2G or 4G networks given the limited availability of most LPWAN alternatives. This has created issues with battery life, and devices need to be replaced every six months in some scenarios.[18]

Spotlight 3
Garv Toilets, IoT-enabled smart public toilets

GARV Toilets provides prefabricated public toilet units that are manufactured in India. Deployed in 12 states, the toilets integrate IoT devices such as PIC microcontrollers, proximity sensors and motion sensors (to automate lighting and ventilation). The devices are connected by 4G networks, enabling real-time updates on toilet usage and information on users' hygiene behaviour (e.g. handwashing). The cost of the solution is approximately $900 per toilet.

Waste management

Building on the success of SBM, SBM 2.0 was launched in 2021 to help make Indian cities garbage-free. This fits into the country's Waste-to-Wealth Mission, which deploys technologies to improve waste management. Several cities (e.g. Lucknow, Varansi, South Delhi, Hubli Dharwad) have deployed IoT solutions at scale for this purpose.[19]

The most common application is using IoT to optimise routes for waste collection vehicles, along with alerts on waste container fill levels. These solutions use multiple sensors, cameras and

16. National Institution for Transforming India. (August 2019). *Composite Water Management Index*.
17. Center for Water and Sanitation. (December 2020). *SaniTab as a monitoring tool*.
18. Centre for Development of Advanced Computing. (n.d.). "Sewer Network Monitoring System".
19. Joshi, D. (4 March 2022). "Solid Waste Management – 5G and IOT can change the SWM landscape for India". *Voice & Data*.

GPS systems to gather data that is uploaded to the local government dashboard. Fill level monitoring sensors can be purchased from local companies for around $100 per unit. Several global smart waste management companies also have a presence in India, often through channel partners. Sensors from these firms, with functionalities such as temperature alerts, cost around $150.

Spotlight 4

Real-time tracking of waste collection in Lucknow

Lucknow Municipal Corporation partnered with Indian IoT solution provider Convexicon to implement a solution that would tackle the challenge of delayed household garbage pick-up and spilled waste on roads. The solution uses NFC-coded properties to record the interaction between garbage collectors and households in real time, while fill level sensors notify authorities when the garbage level exceeds 75% of its capacity to optimise collection. The solution integrates sensors and trackers to monitor collection vehicles and provide real-time status updates and alerts if the truck takes an unusually long time. The efficiency gains from the solution have enabled Lucknow Municipal Corporation to increase door-to-door collection coverage from 60% in 2020 to 100% in 2022.[20]

Transport

India's Ministry of Housing and Urban Affairs (MoHUA) has focused on developing smart transport systems to help different modes of transport co-exist in a cohesive manner. These systems leverage multiple IoT applications, including traffic management, automatic vehicle detection, fleet management and electronic fare systems. Such platforms have been deployed by local governments in many cities, such as Navi Mumbai, Pimpri-Pune and Raipur.

With mobile operators offering a range of smart mobility solutions, including asset tracking and fleet management, IoT solutions in India's transport sector can be expected to grow. IoT applications in the transport sector are also likely to grow as a result of India's push towards electric vehicles (EVs). There are already more than 900 EV public charging stations in India, which can be located on India's EV web portal.[21] Moreover, many cities, such as Delhi, have ambitious plans to deploy fleets of electric buses.[22]

Drone applications are also on the rise, supported by the recent publication of national drone rules and government ambitions to make India a global drone hub by 2030. Most activity so far has centred on the use of drones for deliveries across industries like health care, food and last-mile services. These deployments have primarily been small-scale trials and proof of concepts, reflecting India's growing drone start-up scene.[23]

Spotlight 5

IoT for bus rapid transit systems in Ahmedabad, Pune and Surat

The use of IoT-based platforms and data collection devices in public transport is common in Indian cities. For instance, Japanese company NEC partnered with Urban Mass Transit Company, part of the MoHUA, to provide bus rapid transit systems in cities like Ahmedabad, Pune and Surat. NEC provides solutions such as automatic vehicle location, passenger information systems, vehicle planning scheduling and dispatch and depot management. The company supports a fleet of more than 4,000 public buses in India, deploying solutions to help operators reduce costs and increase revenues.[24]

20. Convexicon India. (2022). Lucknow: *Cleaning its way to the top*.
21. To view the charging map, see: https://e-amrit.niti.gov.in/charging-map.
22. Business Standard. (17 January 2022). "Delhi govt aims to bring 2,000 electric buses in coming years: CM Kejriwal".
23. Singh, V. (17 May 2022). "Will India lead the drone delivery industry in the world?". *Times of India*.
24. Rogerson, S. (4 August 2020) "NEC helps India develop intelligent transportation". *IMC News*.

Annex 1: Use cases considered in the research

Sector	Use case	Description	Benefits	Device(s)
Energy	Smart metering	◦ Accurately records and automatically transmits energy usage data in real time	◦ No longer need to send staff to customers' premises to read their meter or rely on customers to report the meter reading themselves ◦ Allows utilities to introduce time-based tariffs to manage demand ◦ Allows for alternative energy planning and modelling ◦ Allows for cost savings, energy theft monitoring, etc.	Meters
	Smart grid	◦ Tracks the distribution network in real time, providing measurements of voltage sags, swells, interrupt information and other metrics	◦ Enables energy companies to redirect resources when demand on the grid is increasing ◦ Find and resolve faults more quickly, improving the customer experience ◦ Reduced risk of fines from service level agreement (SLA) breaches	Sensors (e.g. current, voltage)
	Microgrids	◦ Sensors embedded on solar photovoltaic (PV) installations (e.g. a microgrid run by a smallholder or large-scale solar farm) to monitor production and distribution	◦ Avoids fossil fuel-derived emissions (mostly coal) ◦ Optimises power consumption at residential and industrial premises by using stored energy (rather than relying on the grid)	Meters, sensors (e.g. current, voltage)
	PAYG cooking and SHS	◦ IoT-enabled devices include connected LPG cylinders and electromagnetic induction stoves ◦ Solutions collect usage data and relay information to users (e.g. reminders to charge battery, make payments)	◦ Make services more affordable for poor consumers because they can make micropayments ◦ Enables credit scoring for unbanked users ◦ More effective revenue collection for service providers	Meters, sensors (e.g. temperature), GPS

Sector	Use case	Description	Benefits	Device(s)
Water	Smart metering	◦ Accurately records and automatically transmits water usage data in real time	◦ Lower staff costs and improved reading accuracy ◦ Leaks are easier to identify and fix, enabling utilities to reduce their NRW costs ◦ Introduce new services (e.g. a PAYG option for lower income customers) ◦ Provides visibility into water contamination and pH levels	Meters
	Water ATMs	◦ ATMs automatically dispense water for which customers prepay ◦ ATMs are IoT-enabled, allowing real-time monitoring	◦ Provides visibility into the volume of water dispersed and number of users ◦ Measures leakage and water quality ◦ Some solutions combine water ATMs with a water treatment solution for purifying water	Meters, connected water purifiers, pH sensors
	Water treatment	◦ Tracks filter usage to ensure filters are replaced on time to avoid contaminants entering the system ◦ Measures the chemical properties of downstream water	◦ Helps to prevent compliance issues by keeping alkalization of water within permissible levels and avoiding potential health risks ◦ Reduces system downtime and maintenance	Connected water purifiers, pH sensors, oxidation reduction potential (ORP) sensors
	Supply network monitoring	◦ Monitors water pressure and flow in pipes to detect leaks and predict bursts ◦ Measures the temperature of the output of the safety valve, which falls rapidly before leakage occurs	◦ Enables the early detection of faults to avoid unscheduled shutdown and maintenance ◦ Improves uptime of water pipe network	Water flow meter, sensors (pressure, temperature)
Sanitation	Wastewater monitoring	◦ Placing sensors in sewer lines and waterways to monitor the flow of sewage, breakage and leakage	◦ Improves understanding of pathogen levels in rivers ◦ Improves understanding of sewage value for upcycling	Sewer level monitoring sensor, acoustic sensor, camera
	Smart toilets	◦ Provides insights into public toilet usage and cleanliness	◦ Automates toilet cleaner, reducing maintenance needs	Ambient monitoring sensor, motion sensors
	Pit fill level monitoring	◦ Use of IoT devices to monitor and send alerts on fill levels and overflows ◦ Can be combined with real-time tracking of service vehicles	◦ Ensures safer and more efficient disposal of faecal sludge for a cleaner and healthier city	Fill level sensor, vehicle tracker

Sector	Use case	Description	Benefits	Device(s)
Waste management	Smart bins	◦ Enables the location and fill level of waste containers to be monitored remotely ◦ Often combined with real-time tracking of service vehicles	◦ When a waste container is almost full, an alert is set to arrange a pickup even before the pre-scheduled time ◦ Understanding the geography of emptying patterns helps to forecast future needs	Trackers (container, vehicle, workforce), fill level sensor, temperature sensor
	Smart recycling	◦ IoT devices can be used to weigh recyclable waste ◦ More sophisticated machinery can be used to automate waste segregation	◦ Increases recycling rates ◦ Reduces open degradation of organic waste (and the growth of microorganisms)	Scales, sensors (e.g. ultrasonic, colour), servomotor
Transport	Smart public transport	◦ Real-time tracking of public transport vehicles allows transport operators and commuters to see where vehicles are ◦ Transport operators can receive additional data on how vehicles are driven	◦ Passengers benefit from a more predictable and reliable public transport service ◦ Enriches the quality of long-term public transport and urban planning ◦ Onboard cameras can improve driver and rider safety	Vehicle tracker, CCTV cameras
	EVs	◦ Sensors on EVs to monitor fuel consumption and routing ◦ EV charging point sensors provide location beacons for passing EVs	◦ CO2 savings from substituting fossil fuels for electricity and embedding sensors in EVs ◦ Charging point sensors avoid wasted emissions from searching for a charging point	Charging point sensors, EV sensors
	Asset tracking	◦ IoT devices can be attached to shipping containers, trailers, pallets and even individual packages to monitor transportation	◦ Reduces lost items ◦ Helps companies ensure their products are being transported under the right conditions	Trackers and sensors (e.g. temperature, humidity, moisture)
	Drones for deliveries	◦ Drones can be used to deliver items (e.g. medical supplies) from one location to another	◦ Provides a more environmentally friendly and efficient delivery service (in certain conditions) compared with traditional methods	Light detection and ranging (LiDAR) sensors, GPS/ GNSS, gyroscopes, accelerometers

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