GSMA

IoT and Essential Utility Services:
Nigeria market case study

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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.

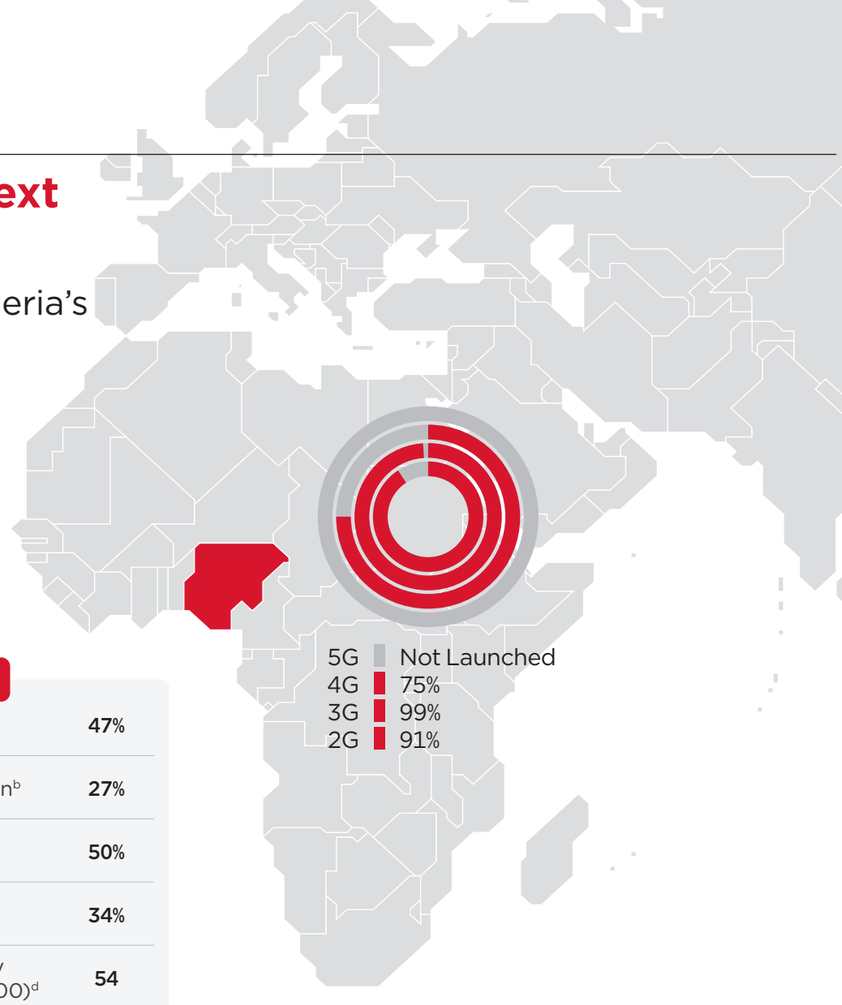
— *IoT and Essential Utility Services: Opportunities in Emerging Markets* – this report summarises the IoT opportunity across the the utilities sectors and draws together lessons from the five market case studies.

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 Nigeria's mobile market



Nigeria	
Mobile penetration[a]	47%
Mobile internet penetration[b]	27%
Smartphone adoption[c]	50%
Made or received a digital payment	34%
GSMA Mobile Connectivity Index (MCI) score (out of 100)[d]	54
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.

Nigeria is home to the largest mobile market and economy in Sub-Saharan Africa, representing a significant opportunity to scale IoT solutions in the region. The federal government has implemented large-scale metering programmes that are driving adoption in the sector. For example, the Meter Asset Provider (MAP) programme was launched in 2018 and the National Mass Metering Programme (NMMP) in 2020. These two programmes aimed to collectively install 6.5 million meters by the end of 2022 to improve grid management. As a result, a growing number of smart meter manufacturers are now operating in Nigeria. Similar large-scale technology programmes in other utility areas could also benefit the country's IoT ecosystem.

One of the main barriers to IoT adoption in Nigeria is mobile and mobile internet penetration, which is the lowest of the five case study countries. At the end of 2021, 63% of Nigerians living in rural areas were not connected to mobile internet, compared to 40% of people living in urban areas.[1] Efforts to extend mobile broadband coverage, underpinned by the use of refarmed 900 MHz spectrum, should aid mobile internet uptake in the next few years.

1. GSMA. (2022). *The State of Mobile Internet Connectivity 2021*.

There are a growing number of LPWA technologies in Nigeria. For example, MTN offers narrowband IoT (NB-IoT) services, IoT Africa Networks provides Sigfox coverage and Internet Services Nigeria (ISN) and Nova Track Limited offer public low-range wide area network (LoRaWAN) services. However, coverage of these LPWA technologies is still largely limited to Lagos.

The energy and transport sectors are leading the roll-out of IoT solutions in Nigeria. Both sectors have had multiple deployments across the focus areas, reflecting growing interest from a range of private and public sector organisations. However, IoT is playing a more limited role in delivering water, sanitation and hygiene (WASH) and waste management services. While there is a clear need for fresh thinking to tackle the mounting problems in these areas, limited budgets and lack of technical expertise remain significant barriers. The latter is reflective of a nascent ecosystem in which mobile operators and providers of unlicensed LPWA technologies are focused on a narrow set of use cases, namely, smart metering and asset tracking.

Figure 2

Heatmap of IoT in Nigeria'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

There is strong demand for IoT solutions in Nigeria's energy sector, which have been driven by recent government initiatives. In 2020, the Nigerian government announced plans to introduce service-based tariffs aimed at addressing the fundamental challenge in the Nigerian energy sector: tariffs are too low to cover costs, which leads to underinvestment and poor service. Yet, it is this poor service that makes rising tariffs politically unpalatable. The new tariffs aim to break this cycle by linking the amount a consumer pays to the quality of service the same consumer receives.[2]

To roll out service-based tariffs effectively, Nigeria needs to deploy smart meters that can determine service quality by providing real-time insights into household energy usage. The Nigeria Electricity Regulatory Commission (NERC) estimates there is a metering gap of more than 10 million. This led to the development of the NMMP, which provides government-backed loans to local energy distribution companies to purchase meters from local manufacturers, such as MOJEC International.

MOJEC has pioneered smart meter manufacturing in Nigeria, setting up a plant with a production capacity of 1.5 million meters annually to serve utilities based in Nigeria and other African markets. This example, as well as others in case study countries such as India, highlight the viability of onshoring smart meter manufacturing when supported by a large-scale national metering programme and local initiatives to build a talent pool of workers with suitable skill sets. This can encourage other firms to begin manufacturing meters in the country. For example, SteamaCo has set up a manufacturing line in Nigeria to produce some of their smart meter hardware. It is worth noting that local smart meter manufacturing initiatives from companies in Nigeria exclude hardware such as chipsets that require significant upfront investment. It is unlikely that these components will be manufactured at scale in Sub-Saharan Africa or South and Southeast Asian markets anytime soon.

In addition to leveraging IoT solutions to improve the quality of Nigeria's energy supply, the government is also exploring how the technology can support efforts to connect off-grid households. For example, the use of smart meters to monitor and control minigrids, which are an important part of the Nigeria Electrification Project.[3] The first microgrid site was launched in Nigeria in 2017, seven years after Kenya.

Nigeria also has a significant urban off-grid market, which has led to widespread use of small diesel generators. This is a major contributor to household pollution, creating a gap for innovative renewable solutions. Local pay-as-you-go (PAYG) solar providers have been targeting this opportunity. For example, more than 60% of Lumos' customer base in Nigeria can be classified as urban or peri-urban.[4] IoT-based PAYG solutions are becoming more prevalent in other areas, such as clean cooking, but start-ups face certain challenges. Financial inclusion in Nigeria lags many other LMICs, with just over half of Nigerians using formal financial services as of 2020.[5] This is due in part to the country's nascent mobile money sector, which limits the addressable market for providers of PAYG-based solutions.

2. Ali, Y.O. and Walsh, G. (14 October 2021). "Power Africa Success Story: Nigeria's Tariff Reform Delivers Major Financial and Environmental Benefits". Tony Blair Institute for Global Change.
3. Implemented by the Rural Electrification Agency, the Nigeria Electrification Project aims to provide cost-effective power to 1 million households through off-grid and mini-grid systems by 2023.
4. Bauer, G.K. (17 July 2019). "Why off-grid energy providers are increasingly paying attention to urban areas – insights from the DRC and beyond". *GSMA Mobile for Development Blog*.
5. EFInA. (2021). *Key Findings: EFInA Access to Financial Services in Nigeria 2020 Survey*.

Spotlight 1

Mini-grid roll-outs in Nigeria

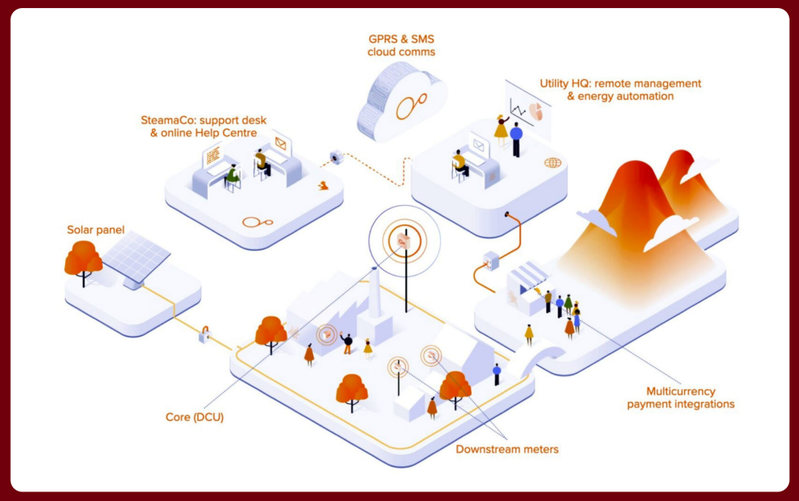
In September 2022, Ceesolar Energy Limited, a Nigerian-based renewable energy company, signed a performance-based grant (PBG) agreement under the Nigeria Electrification Project to develop a mini-grid for the Abaribara Community in Cross River State, South Nigeria. More than 200 households and local businesses will be connected through the project, serving approximately 1,000 residents.

As part of the deployment, Ceesolar Energy will team up with SteamaCo, which will provide their IoT smart metering platform and hardware. This includes SteamaCo's Edge 6 smart meter, Data Concentrator Unit (DCU) and cloud-based central hub for managing minigrid sites remotely. SteamaCo uses SMS to send data via 2G and 3G networks, as they view this as the most reliable form of communication in off-grid areas.

Despite strong momentum for minigrids in Nigeria, highlighted by the growing pool of smart meter suppliers like SteamaCo, the business case remains a challenge. Analysis from the African Minigrid Developers Association (AMDA) indicates that metering is equal to 15% of the total installation cost of a minigrid, which was around $1,400 per connection in 2019.[6] This is in addition to operating expenditure (OPEX) costs, which tend to be in the low single digits in most markets.

According to the AMDA, the average monthly revenue per unit for minigrids in Nigeria is $4.83. This highlights the importance of the government's PBG, which helps to improve the viability of solar mini grids deployed in unserved areas by offering minigrid developers $600 per connection.

Figure 3, The SteamaCo IoT smart metering platform



Source: SteamaCo[7]

6. AMDA. (2021). *Benchmarking Africa's Minigrids*.
7. For more information, see: https://steama.co/off-grid-smart-metering-platform

Water

In 2018, the Nigerian President declared a state of emergency in the WASH sector, as 60 million Nigerians – 30% of the population – were living without access to basic drinking water. Challenges to increasing water supply include limited distribution networks, inadequate power supply from the national grid and frequent pipe leakages. It is estimated that Lagos alone requires an additional N300 billion (~$680 million) each year to achieve universal safe water access.[8] Donor funding will be key to narrowing this gap. Since 2021, the World Bank, WaterAid and USAID have all made new commitments to support Nigeria's water sector. This could pave the way to explore how IoT solutions could improve water access, an area that has received relatively little investment to date. One example is the use of IoT solutions to monitor critical infrastructure in remote settings, as seen in a recent deployment by Virridy and the World Bank that used low-cost satellite-connected sensors.[9]

Spotlight 2

Smart water meter trials in Lagos on the Sigfox network

Most Nigerian water supply connections are not metered, although there is growing interest from companies such as IoT Africa Networks (the exclusive Sigfox distributor in Nigeria) in deploying smart meters.[10] IoT Africa Networks covers around 85% of Lagos with their Sigfox network and targets a wide range of use cases in sectors including oil and gas and water. Through a partnership with hardware provider Kamstrup, they are deploying smart water meters to help water utilities and private sector vendors lower their non-revenue water (NRW) costs. Reducing water leakage is increasingly important in Nigeria as severe water shortages are becoming more common.[11]

Sanitation

Following the state of emergency declaration, a national campaign was launched called Clean Nigeria: Use the Toilet, which aims to eliminate open defecation in Nigeria by 2025.[12] Against this backdrop, there is a desire for increased private sector engagement in the sanitation sector and, therefore, potential for local innovators to use IoT and other digital technologies to tackle the problem. However, there is still a relatively weak understanding of how to involve the private sector, and our research found little evidence of IoT being used to support the delivery of services in the sanitation sector. The Toilet Board Coalition released a report in 2021 outlining the potential for Nigeria to harness smart technologies in the sanitation sector.[13] They estimated that the country's smart sanitation economy could be worth $2.6 billion by 2030, with sensor-fitted toilet technologies accounting for half this total.[14]

Transport

Nigerian mobile operators have focused most of their IoT efforts on providing connectivity. There are some exceptions, however, such as the transportation sector where MTN offers a range of fleet management solutions, including asset tracking, vehicle tracking and driver management. These IoT use cases are among the most mature in Nigeria and are driving interest from a range of other players, including public LoRaWAN providers (e.g. Nova Track Limited) and local IoT start-ups (e.g. Gricd).

8. Akoni, O. (29 June 2021). "Lagos requires N300bn yearly to achieve access to safe water – WaterAid". *Vanguard*.
9. Thomas, E. (19 May 2022). "Virridy contracted by the World Bank to partner with WaterAid Nigeria". Virridy.
10. Utomi, J.M. (25 March 2022). "World Water Day 2022 and Lagos' acute water scarcity". *The Guardian*.
11. Akinwa, J. (17 February 2022). "What if you could control water?" IoT Africa Networks.
12. According to the latest numbers from the WHO and UNICEF in the Joint Monitoring Project (JMP) of 2019, only 39% of Nigeria's population have access to safely managed and basic sanitation, while 24% of the population still defecates in the open.
13. Toilet Board Coalition. (2020). *Sanitation Economy Markets Nigeria*.
14. The smart sanitation economy is defined as a digitised sanitation system that optimises data for operating efficiencies, maintenance, consumer use and health information insights.

IoT is playing a role in several other areas within Nigeria's transport sector. For example, IoT technologies are being used to support Nigeria's public transport systems, including the Lagos Bus Rapid Transit (BRT) service. The use of IoT to enable delivery drones and support electric vehicle (EV) infrastructure is less mature. Nigerian start-ups such as Arone and Lifebank tested the use of drones for medical deliveries, both have since shifted their focus. This has provided an opportunity for international drone companies to enter the market,[15] highlighting the value of scale in building the organisational and financial resources necessary to tackle the commercial and technical challenges of drone deployment. Scale is also likely to be an important driver of success in the EV market, highlighting the importance of venture capital funding and regional expansion to Nigeria's automotive start-ups.[16]

Waste management

Waste management in Nigeria is largely informal, characterised by disaggregated waste pickers, overflowing landfills and dumpsites. This is epitomised by Lagos, which churns out about 13,000 metric tonnes of waste daily, with municipal authorities collecting only 40% of it.[17] Innovative private sector alternatives are therefore needed to help tackle the challenge.

IoT has played only a limited role in Nigeria's waste management sector to date. Start-ups like GIVO and Scrapays are using IoT devices to support their circular economy solutions, but other IoT applications, such as tracking waste collection vehicles and monitoring waste containers, remain in the development phase.[18] Several obstacles need to be overcome to reach commercialisation. For example, there is a perception among some public sector stakeholders that the data collection associated with IoT and some other digital solutions is an expensive and secondary venture that does not fall within their core service mandate.[19]

Spotlight 3

Emerging waste management innovations in Nigeria

Smart recycling: GIVO (Garbage In Value Out) is a circular economy company based in Lagos. It offers an end-to-end recycling solution using IoT-enabled devices to collect recyclable material directly from individuals and businesses. GIVO then processes these materials into consumer and industrial goods. GIVO partners with mobile money service providers to enable cashless transactions.

Smart recycling: Scrapays is for individuals and enterprises looking to make money or get a better return from recyclable waste. The start-up uses a "decentralised recovery network" that consists of agents (who list their space as a temporary recyclable hosting location) and collectors (people who collect recyclables in their mapped zone). Scrapays provides agents with IoT-enabled scales to weigh recyclables and transfer the results to the Scrapays agent app. The scales can be monitored and locked remotely, which allows Scrapays to provide the scales to agents without an upfront payment.

15. Osuagwu, P. (14 September 2022). "Nigeria joins Ghana, Rwanda and others to deliver health services via drones". *Vanguard*.
16. Bloomberg. (21 July 2022). "Nigeria startup to expand electric vehicle use in African push". *Gulf Business*.
17. Egbejule, E. (18 April 2019). "The women trying to solve Lagos' waste problem". *Al Jazeera*.
18. Afolalu, A.S. et al. (2021). "Development of Smart Waste Bin for Solid Waste Management". *International Journal of Sustainable Development and Planning*, 16(8), pp. 1449–1454.
19. Njoroge, B. (14 December 2021). "Enabling Government-Innovator partnerships in Lagos: Insights from our workshop". *GSMA Mobile for Development Blog*.

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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