GSMA

IoT and Essential Utility Services:
Indonesia 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.

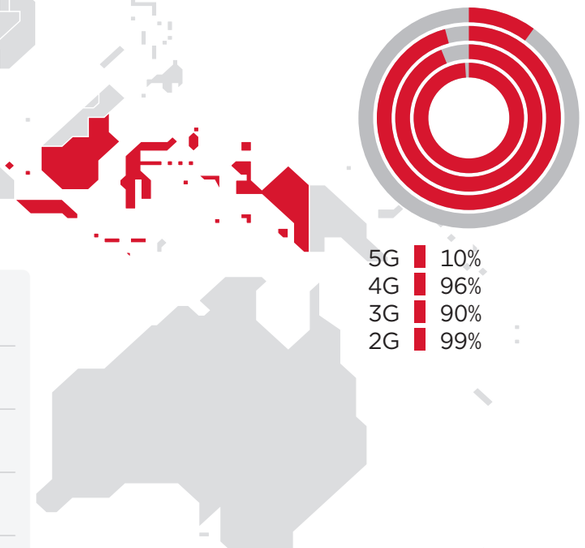
The 17 IoT use cases we examined are in no way an exhaustive list, but were selected as the use cases most likely to be implemented in the five markets we reviewed, and have significant benefits for utility providers and customers. Annex 1 provides additional details on the use cases and key benefits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



Indonesia	
Mobile penetration[a]	55%
Mobile internet penetration[b]	46%
Smartphone adoption[c]	82%
Made or received a digital payment	37%
GSMA Mobile Connectivity Index (MCI) score (out of 100)[d]	69
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.

The largest market in Southeast Asia, Indonesia has recorded rapid GDP growth in recent years, supported by a growing start-up ecosystem. The Indonesian Stock Exchange includes notable listings of regional tech giants. Consumer apps and fintech have been dominating Indonesia's start-up scene, but innovation is spreading into new areas, including IoT, as start-ups seek new opportunities. This is happening alongside major government-led initiatives, such as the Making Indonesia 4.0 roadmap and the 100 Smart Cities Movement, which encourage the use of IoT across different industries.

Indonesia scores highly on GSMA Mobile Connectivity Index, reflecting a higher level of smartphone adoption, digital skills and locally relevant content and services. Indonesia's IoT deployments benefit from the availability of low-power wide area networks (LPWANs) from multiple providers, including three narrowband IoT (NB-IoT) networks (Indosat, Telkomsel and XL Axiata), two low-range wide area networks (LoRaWANs) (Telkom and Everynet) and one Sigfox network (Sigfox Indonesia). NB-IoT and LoRaWAN have been deployed in multiple regions across

Indonesia. Sigfox is the most nascent of the LPWA technologies, having just launched in Indonesia in 2020. There is also an increasing number of device manufacturers supporting IoT deployments, particularly in areas such as smart meters, although deployments still rely heavily on imports, particularly from China.

IoT deployments are underway across the main utility sectors in Indonesia. In many cases, deployments have been supported by the country's mobile operators, which have advanced IoT strategies. This is demonstrated by the roll-out of LPWANs and the end-to-end solutions offered by mobile operators across multiple use cases. The IoT ecosystem is maturing in other ways as well, with specialist players (e.g. system integrators) and start-ups becoming increasingly involved in IoT deployments.

Despite the potential, IoT deployments in the utility sectors are still relatively small scale. This should begin to change as companies gain more IoT experience and smart city deployments ramp up as municipalities adopt more ambitious plans to leverage IoT solutions to solve different challenges.

Figure 2

Heatmap of IoT in Indonesia'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

The island geography of Indonesia makes it a difficult country to power. While Java enjoys a stable supply of electricity, many eastern islands suffer from coverage and reliability issues. IoT solutions can ease these challenges, but most implementations have been limited to small-scale deployments. This should begin to change as the Government of Indonesia and state-owned utility State Electricity Corporation (PLN) plan to roll out smart meters to 79 million people by 2027.

Smart meters have been deployed in most solar microgrid deployments in Indonesia, such as those by Electric Vine Industries (EVI) and Inovasi Dinamika Pratama (IDP). The total impact of solar microgrids on Indonesia's energy generation remains small, however, with solar and wind energy accounting for only 11% of generation capacity in 2021.[1] However, deployments can be expected to ramp up as the country aims to meet a target of 23% renewables in the energy mix by 2025.[2] Microgrids are also an important part of Indonesia's rural electrification strategy, given the challenges of extending the national grid to remote islands and areas prone to natural disasters.

Indonesia's evolving energy mix will require a smarter grid system to manage energy generation from a wider range of sources. While small pilot projects are underway (e.g. Siemens' PoC on Sulawesi Island), wider deployments are heavily dependent on the government confirming their plans.[4] Other IoT solutions, such as pay-as-you-go solar home systems (PAYG SHS) or clean cooking products, are less commonly used in Indonesia than other case study countries in our research. The lack of PAYG SHS reflects the country's high electrification rate[5] while heavily subsidised LPG connections limits the use of PAYG clean cooking products.[6]

Spotlight 1
IoT-enabled minigrids in Indonesia

EVI has installed solar PV microgrids on the islands of Papua and Sumba in the East Nusa Tenggara province of Indonesia, which has the lowest electrification rate of all provinces (72%). EVI's microgrid captures, stores and distributes clean energy using hardware such as smart inverters and meters. The prepaid electricity accounts use mobile phone apps for payments along with an overview of usage, balance and payment history. Since coverage gaps in rural areas restrict the use of the mobile app for payments, EVI is currently providing their Wi-Fi network, especially in the Sumba region.[3]

Spotlight 2
Onshoring meter manufacturing in Indonesia

The Indonesian government is keen for the local IoT ecosystem to support PLN's smart meter roll-out. MNOs will play a key role. PLN is working with Telkomsel in Jakarta to implement advanced metering infrastructure (AMI) using the operator's NB-IoT network. The AMI consists of a smart meter, communication layer and an application system on the server.

Local manufacturers will also have an important role to play in the smart meter roll-out. While there are few Indonesian companies designing or producing smart meters, global smart metering companies such as EDMI Limited have manufacturing plants in Indonesia that will be crucial to meeting the government's criteria for locally assembled devices. EDMI has already partnered with several of the country's mobile operators, including Telkomsel, offering their hardware solution and end-to-end platform. This will give the customer real-time readings while also enabling PLN to control status, manage supply and receive up-to-date data.

1. International Energy Agency (IEA). (2022). "Indonesia". Accessed December 2022.
2. IEA. (2022). *Enhancing Indonesia's Power System: Pathways to meet the renewables targets in 2025 and beyond*.
3. Sarin, R. (16 September 2020). "Electric Vine Industries – Powering remote communities with microgrids in Indonesia". *GSMA Mobile for Development Blog*.
4. Dharmaraj, S. (13 February 2022). "Smart Grid Systems to power Indonesia". *OpenGov*.
5. 97% of Indonesia's population had access to electricity in 2020, according to the World Bank.
6. LPG subsidies reached IDR 137 trillion ($9.7 billion) in 2019, according to the International Institute for Sustainable Development (IISD). (2021). *LPG Subsidy Reform in Indonesia: Lessons learned from international experience*.

Water

Water resources in Indonesia are unevenly distributed across the country, with some regions enjoying good access while many others facing water stress in the dry season.[7] Water management challenges begin at the source; more than half of Indonesia's rivers are heavily polluted.[8] The water sector can therefore benefit from using IoT, particularly for water monitoring and treatment. However, the adoption of such solutions is limited since most IoT activity is focused on smart metering and privately installed treatment plants. Even then, Indonesia faces similar challenges as the other case study countries when it comes to deploying smart meters in the water sector. That is, the low price of water makes it harder to justify investment in smart metering infrastructure, which can reach up to $400 per household, according to our interviews.

Spotlight 3

Smart water monitoring on Talkomsel's NB-IoT network

Telkomsel has collaborated with local government-owned water utility Perusahaan Daerah Air Minum (PDAM) to deploy a smart metering system. The system provides pressure, temperature and water-level data directly to PDAM every 30 minutes. The solution uses NB-IoT to connect smart meters, extending the battery life of smart meters and enabling denser deployments compared with 2G, 3G and 4G networks.

Sanitation

Indonesia has seen modest progress in the sanitation sector in the past decade. According to the World Bank, 86% of the population had access to at least basic sanitation services in 2020, up from 74% in 2015. Indonesia has experimented with the use of smart public toilets under a public health programme run in partnership with Mercy Corps and USAID. However, deployments did not move past the trial stage, highlighting the challenge of developing a commercially viable model for IoT-enabled toilets. Wastewater IoT solutions in the public sector are also rare, despite the clear need for new solutions in this area. In Indonesia, only 7% of municipal wastewater is safely collected and treated, and almost 93% is discharged into waterbodies untreated.[9]

Growth in the deployment of wastewater IoT solutions in the private sector is being driven by new regulations aimed at reducing environmental harms. The Ministry of Environment and Forestry (MoEF) introduced a law in 2019 stipulating that 12 industries must implement IoT solutions to monitor the wastewater they generate in real time. A year after introducing the law, the government had installed monitoring instrumentation at 24 river locations and two effluent discharge sites owned by private companies. Data from the sites is fed directly to the MoEF's platform, providing immediate access to data to improve decision-making.[10] The regulation has also provided an opportunity for local IoT solution providers to achieve greater scale, aided by the introduction of novel pricing models. For example, Lintasarta provides a GSM-based wastewater quality measurement solution that is available on a monthly subscription without upfront costs.

Waste management

Indonesia's MoEF aims to reduce waste by 30% and waste handling by 70% by 2025. Policies like "Towards 100 Smart Cities" and "2025 Clean-from-Waste Indonesia" encourage the use of IoT to achieve the ministry's aims. MNOs are supporting these objectives by adapting their fleet management solutions to support was te collection. For example, Telkomsel's FleetSight solution enables waste management companies to improve efficiency by combining data obtained from sensors in waste containers and vehicle trackers to optimise collection routes.[11] The solution does not appear to have been deployed at scale, but it nevertheless highlights the potential for IoT applications in this area. Various other IoT-based solutions are available in the waste management sector, such as sensors in smart bins and data-driven waste collection for recycling vendors. While the use of these solutions is not yet widespread, demand is expected to increase with the growing maturity of local solution providers and capacity building efforts of local governments.

Spotlight 4

Optimised recycling through IoT-enabled waste containers

Rekosistem is a responsible waste management start-up that aims to create a sustainable ecosystem using mobile technology and environmentally friendly methods. Rekosistem created ReBox, an IoT-enabled waste container designed to improve recycling by optimising waste segregation and collection rates. Users are then rewarded for proper disposal through the Rekosistem mobile app. As of June 2022, Rekosistem's total recycled waste has exceeded 1,000 tonnes, collected from around 50 corporations and 11,000 households.

Transport

As a part of a move towards smarter cities, the Ministry of Transport encourages the application of smart transport systems. This is driving the use of IoT in public transport, although it is still limited to a few big cities. For instance, TransJakarta buses have onboard units that send information like bus position, speed and direction to the city's smart city portal. The information is available in real time, allowing citizens to adjust their schedule accordingly.[12] These systems have emerged as an early 5G use case for MNOs in Indonesia, with the technology's enhanced bandwidth and lower latency crucial to applications such as operation control and video surveillance.

IoT technologies can also help achieve Indonesia's goal to become a leader in electric vehicles (EVs). The government, supported by the PLN, aims to build 32,000 public charging stations by 2030, and has introduced incentives such as tax discounts for EV owners. As one of the world's largest motorcycle markets, the government has set an ambitious goal to increase the number of electric motorbikes on the country's roads.[13] Local companies like Wika Industri, Viar and Smoot Motor manufacture electric vehicles, while IoT solutions for real-time monitoring and tracking are also common, particularly for e-bike sharing.

Spotlight 5

Joint agreements driving smart public transport

MNO Indosat Ooredoo Hutchison and PT Industri Kereta Api (INKA), a state-owned company, signed a Memorandum of Understanding (MoU) in March 2022 to introduce IoT-based public transportation solutions.[14] Indosat will be using 4G and 5G technologies for solutions like seamless integrated transportation systems, autonomous vehicles and smart maintenance. The solutions will cover trains, buses and trams with operation control systems, video surveillance and mobility-as-a-service (MaaS) platforms.

7. De Jong, I.H. (21 May 2022). "Water Security Underpins Indonesia's Vision 2045". *The Water Blog, World Bank Blogs*.
8. World Bank Group and Global Water Security & Sanitation Partnership (GWSP). (2021). *Indonesia: Vision 2045: Toward Water Security*.
9. Ibid.
10. Taylor, H. (20 April 2020). "Indonesia turns to remote water monitoring for regulatory compliance". *In-Situ*.
11. Center for Water and Sanitation. (December 2020). *SaniTab as a monitoring tool*.
12. Centre for Development of Advanced Computing. (n.d.). "Sewer Network Monitoring System".
13. Sriratnasari, S., Wang, G. and Jayadi, R. (2019). "Integrated Smart Transportation using IoT at DKI Jakarta". 2019 International Conference on Information Management and Technology (ICIMTech).
14. Tanaka, A. (16 June 2022) "E-bikes in Indonesia and stormy skies for China's cloud giants". Nikkei Asia.
15. KIJANG. (2022). "IOH collaborates with INKA introduces IoT-based public transport solution".

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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