



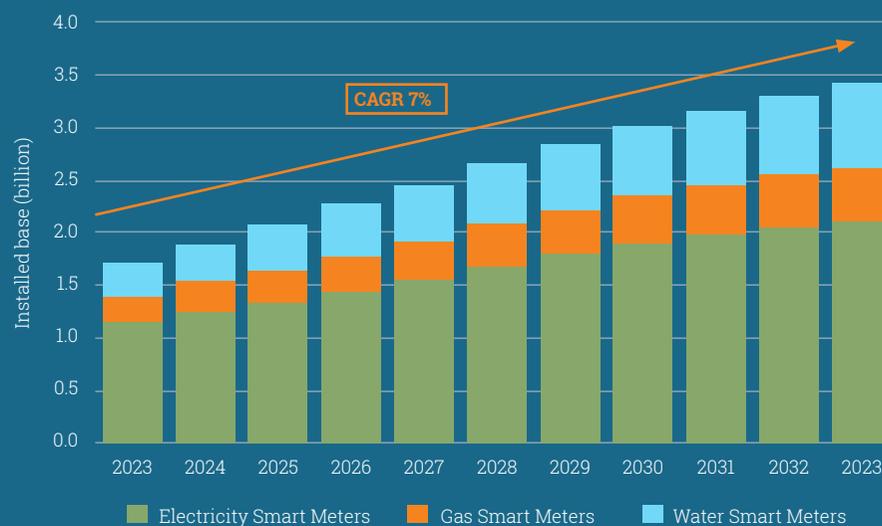
**How eSIM is enabling expanded smart meter functionality with connectivity out-of-the-box**

## Introduction

With more than one billion smart meters now deployed it would be easy to imagine the market is saturated and growth is set to tail off. This is far from being the case with vast new roll-outs underway in developing markets and a vigorous, high volume market for replacing first generation meters in mature markets. IoT Analytics has reported that total deployments of smart meters, comprised of electricity, water and gas meters, passed 1.06 billion at the end of 2023<sup>1</sup>, demonstrating how these devices have become essential enablers for optimised consumption across all utilities.

This growth is borne out by **Figure 1** which details Transforma Insights' projections across electricity, water and gas meters. This reveals that total meter deployments will hit three billion at around the turn of the decade.

**Figure 1: Global smart meter forecast 2023-33**



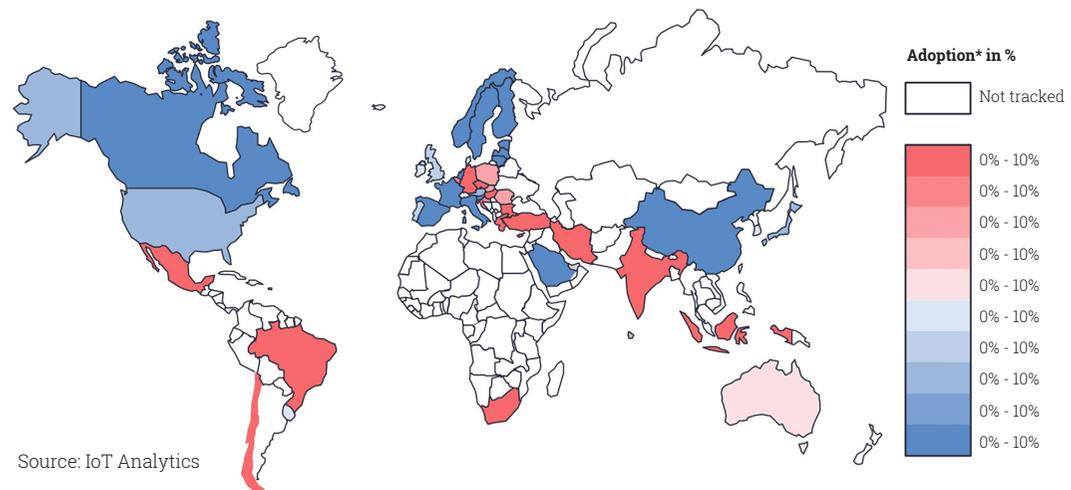
Source: Transforma Insights IoT Forecast Database, 2024

<sup>1</sup> <https://iot-analytics.com/wp-content/uploads/2024/02/INSIGHTS-RELEASE-Smart-electricity-meter-market-2024-Global-adoption-landscape.pdf>

A lot of attention is devoted to the market for electricity smart meters which underpin two-way communications between customers that both consume and generate energy via renewables. The latest generation of smart meters are able to do more than their predecessors thanks to edge intelligence and the growing application of AI to meter data. Therefore, smart meter connectivity has become an essential enabler of accurate and timely data flows. Importantly, the latest generation of smart meters are turning to embedded SIMs (eSIMs) to enable wireless connectivity.

This adoption is more pronounced for water and gas meters in urban areas as well as all types of smart meters in more remote situations. Typically, electricity meters can connect easily to mains lines in populated areas so there is less need for wireless connectivity. However, electricity metering increasingly relies on eSIM-based solutions in high interference environments and for situations where meters are located outside of buildings and in hard to access locations.

**Figure 2: Global smart electricity meter adoption 2024**




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## Electricity, gas and water

IoT analyst firm Berg Insight has reported that penetration of smart electricity meters in North America exceeded 82% in 2024. The firm estimates the installed base of smart electricity meters will grow at a compound annual growth rate of 2.9% during 2024–2030, reaching a total of 180.9 million units by the end of the period. Over the next six years, the penetration of smart meters in the US will increase to 91% while in the Canadian market, it will reach 97%<sup>2</sup>. At the end of 2024, the EU27+3 region was home to more than 195 million smart electricity meters and growing at a compound annual growth rate (CAGR) of just under 6%.

Smart gas meters have also been in deployment for many years. In Europe, Berg Insight says smart gas meter installations hit 55.9 million units in 2023<sup>3</sup>. That represents 45% penetration.

The water sector is also seeing substantial growth. Berg Insight has reported that the installed base of water utility advanced

metering infrastructure (AMI) endpoints in Europe and North America is set to double during the 2024-2030 period<sup>4</sup>. The total number of communicating utility water meters – including both AMI and automatic meter reading (AMR) variants – will grow from 170.5 million units in 2024 to 224.6 million in 2030. AMR includes metering points that require readings through drive-by or walk-by operations while AMI involves a network communications infrastructure and supports true IoT connectivity.

The major topic for energy transition and grid modernisation is now AMI 2.0, which shifts data processing closer to the edge or source to enable real-time decision making, which was possible only in the cloud before, with a time delay. While AMI was targeting only bill collection, the AMI 2.0 generation of smart meters features two-way data communication, enabling utilities to not only monitor energy use but also control network functions and respond proactively to grid conditions. These new, largely LTE-M or NB-IoT, meters bring the

much-desired granular visibility into energy consumption and power quality for utilities to handle the complexity of Distributed Edge Resources (DER) like solar, battery storage and increasing EV fleets.



<sup>2</sup> <https://www.berginsight.com/smart-electricity-meter-penetration-rate-in-north-america-reached-82-percent-in-2024>

<sup>3</sup> <https://www.berginsight.com/the-penetration-rate-of-smart-gas-meters-in-europe-reached-45-percent-in-2023>

<sup>4</sup> <https://www.berginsight.com/the-number-of-water-ami-endpoints-in-europe-and-north-america-to-double-in-the-next-6-years>

## Expanded use cases drive new functionality

Modern smart meters do far more than simply count consumption and communicate that infrequently to utilities. The current metering landscape is composed of sensed metering devices, edge routers and substation metering in addition to smart meters. The smart meters themselves are also able to do more, offering the capability to communicate not only about consumption but about anomalies that uncover issues such as a water leak or excessive consumption of gas. These richer-featured devices also enable up to the minute optimisation to support use cases such as electric vehicle charging or to enable the sale of renewable energy back to the grid.

In many markets, smart meter data is increasingly integrated with grid and utility system data to ensure supply is in place to match demand and the data collected can feed predictive maintenance and supply-side availability as well. Cellular connectivity is increasingly recognised, alongside other wireless communication technologies such as LoRa and RF, as a key enabler for smart meters of all types.

Cellular uniquely offers the global coverage that meter manufacturers need – especially with the move to AMI 2.0, which requires a far greater diversity of interoperable devices to avoid fragmentation from proprietary implementations. Don't forget that meters are often global products so a single connectivity solution that is available in all countries where

the meters will be deployed is appealing. Cellular, typically in the form of NB-IoT, LTE-M, LTE Cat 1 and Cat 1 bis, is simple to set up, speeding installation and helping to ensure reliable, secure communication. Greater demands for data may see adoption of technologies such as 5G RedCap to support smart meter communications in future.



## eSIM enables simplified and accelerated operations



The arrival of eSIM has simplified this cellular connectivity landscape further, allowing meters to download a SIM profile automatically when activated. While this has previously been enabled with remote SIM provisioning (RSP), which allows a device to switch its SIM over to another connectivity provider, this process is power-intensive and not suitable for battery-powered smart meters. To make this easier for such devices, the industry has evolved a new IoT eSIM RSP at the GSMA. Instead, eSIM provides a more elegant, streamlined approach provided it is supported by a comprehensive set of technologies and processes. One example of this complete eSIM ecosystem is that put forward by Kigen, which combines the foundational technologies behind eSIM with its own operating system and profile management capabilities.

This OS is able to support switch over to another operator even in memory and power-constrained devices. This is enabled via Kigen's switchover applet within the Kigen OS and utilises Kigen's strong eSIM IoT manager (eIM). This eIM has the licence to switch profiles securely with any subscription manager data preparation plus (SM-DP+). There is no need to set up a new SM-DP+ every time a device needs to change provider.

Kigen acknowledges that other eSIMs can achieve this using the multi-IMSI approach but this can be complex and places different requirements on the eSIM. In contrast, Kigen's system enables multiple profiles to be provisioned from the very start and the switchover logic is seamlessly handled.

## Streamlined provisioning

An essential enabler is in-factory profile provisioning (IFPP) which involves eSIM profiles being integrated into the device during manufacture. IFPP transforms the complexity involved in manufacturing and then shipping meters to individual markets across the globe, enabling a truly global single product to be created with ensuing benefits in logistics, streamlined provisioning and product handovers. Kigen's IFPP enables software-defined provisioning thereby eliminating multiple stock-keeping unit numbers (SKUs) for product variants and reducing long lead times typical for mass scale meter deployments.

Adopting Kigen's OS for products such as electricity smart meters gives utilities and metering manufacturers advantages as they ensure simplified roll-outs. Itron, a very large

manufacturer of meters, has already reported seeing strong results from adopting Kigen's approach to streamline its grid products and all of the top five metering manufacturers are building eSIMs into their products natively with Kigen so they can serve utilities' needs better.

The Kigen eSIM enables SIM profile delivery for smart metering connectivity via a variety of communication protocols, including DLMS/COSEM. These protocols are widely used in utility meters and head-end systems and encompass application layer services and a structured model for smart meter data for AMI 2.0. This is essential for integrating electric vehicle and distributed energy resources data into a comprehensive smart grid solutions. In addition, costs can be saved across in-field updates and operations.



## Use case example 1: Evergy

Evergy is one of the largest investor-owned utilities in the Midwest US and it serves 1.7 million customers across Kansas and Missouri. The utility has selected Kigen to strengthen its grid resiliency and is using Kigen's secure eSIM OS and eIM solution. Evergy's strategy is to unify private LTE and public networks into an automated connectivity layer so it can create a foundation for more reliable operations in the face of severe weather, growing energy demand and the complexity of distributed energy resources (DERs).

As utilities integrate distributed energy resources, AMI and dynamic billing, ensuring uninterrupted connectivity becomes critical. Severe thunderstorms, storm-related outages and routine network upgrades can all disrupt real-time telemetry that forms the heartbeat of a modern grid. Without automation, managing tens of thousands of IoT devices at scale would create unacceptable risks to both service continuity and cost efficiency.

Evergy's LTE network already spans 100 sites, supporting thousands of IoT sensors, AMI and operational technology devices. With expansion expected to reach tens of thousands of devices, failover between private and public networks must be seamless but manual approaches cannot keep pace at this scale.

"As we modernise our grids, uninterrupted device data means visibility and preparation against outages from both the fast-changing energy transition and unpredictable severe weather," commented Bill Franzen, the lead radio engineer at Evergy. "Taking control of our infrastructure requires network availability and automation is the foundation on which dynamic billing and AI can build. Kigen eSIMs and the eIM, configured to Evergy's needs, enable

us to set a new benchmark in grid resiliency - what has long been the holy grail of resilient, intelligent grids."

Kigen's secure eSIM OS and SGP.32-compliant eIM solution provide Evergy with the flexibility to manage connectivity dynamically through eSIMs provisioned with multiple operator profiles. Kigen eSIM OS for IoT and consumer devices includes configurable features such as its network rescue and recovery applet, which enables dynamic, automated failover between private LTE and preferred public networks based on business rules. These operations are centrally managed through Kigen Pulse, allowing control at fleet scale by geography, asset type or site. This ensures continuity of operations, reduces lifecycle costs and supports Evergy's broader goals of capital efficiency, safety and sustainability.

Evergy's deployment relies on the Kigen eIM hosted at its Dublin site, which is fully certified under the GSMA Security Accreditation Scheme for Subscription Management (SAS-SM). This site operates the Kigen eIM solution to the latest GSMA SGP.32 IoT eSIM specification, providing both assurance of compliance and the trusted foundation required for secure, grid-ready operations.

"Building in dynamic automation for scaled failover and recovery, we enable Evergy's vision to design for improved reliability, resilience and operational intelligence," explained Vincent Korstanje, the chief executive of Kigen. "As utilities navigate the energy transition, uninterrupted connectivity is the foundation for AI, dynamic billing and DER integration. With Kigen's configurable eSIM OS and SGP.32-compliant eIM, utilities can take control of their connectivity and create the intelligent grids the future demands."

## Use case example 2: LCRA

The Lower Colorado River Authority (LCRA) has selected Kigen's SIM technology to enhance its communications network across 70,000 square miles. This upgrade will strengthen LCRA's private LTE network, ensuring secure and reliable connectivity for its operations and partners. The company, one of the largest public power providers in Texas in the US, has chosen Kigen to provide new SIM technology to help enable and protect LCRA communications assets.

LCRA is currently deploying its own private LTE network to provide highly reliable and secure mission-critical voice and data connectivity. "Kigen's collaboration with LCRA goes beyond

technology – it's about creating a reliable and resilient network that will serve customer needs for decades to come," said Jean-Louis Carrara, the vice president of North America and Europe Sales at Kigen.

The SIM technology will enhance LCRA's radio system, which covers more than 70,000 square miles in 68 counties. LCRA uses the extensive system for its operations and shares the system with governmental and public safety entities, electric utilities and schools and other public safety entities.

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## Future innovation

Connectivity advances have helped the metering sector redefine its role in utility operations. While compute advances have enabled meters to gather far more granular data and process it to create actionable insights, the ability to communicate this easily has been instrumental in opening up new opportunities to operate more effectively and support customers better. Importantly, technologies such as eSIM are at the forefront of simplifying connectivity and enabling power and memory constrained devices to maximise the value of the data they can communicate.

The next step in the smart journey is the addition of AI, which introduces the ability to analyse truly enormous volumes of data from smart meters, sensors and other resources. This will help utilities predict demand so they can balance supply in real-time. AI will fuel self-healing grids, optimised energy storage and efficient renewable energy generation.

Utilities will benefit from enhanced predictive maintenance and consumers will gain highly personalised energy-saving insights. AI will also support enhanced security for grid infrastructure and enable early identification of anomalies that can forewarn of attacks or fraud.

Easy-to-deploy smart meters that offer reliable, flexible and secure cellular connectivity are vital enablers of this next wave of smart metering. Kigen's eSIM OS enables utilities to unlock the benefits of eSIM and optimise their connectivity in support of this new generation of meter functionality.

Kigen invites all energy utilities, grid operators, connectivity providers, and manufacturers supporting the energy transition to discover its eSIM OS, eIM, and services for building secure, future-ready networks. To learn more, visit: <https://kigen.com/solutions/esim-utilities/>