



# Smart metering for water utilities

## A playbook for a successful AMI implementation

Advanced Metering Infrastructure (AMI) is a transformative solution for water utilities, offering a critical response to a rapidly evolving landscape and helping to achieve key business outcomes, such as improved balance sheets, more efficient operations, and enhanced customer service. As operational costs rise and customer expectations grow, it's clear that the status quo is no longer sufficient. To overcome these challenges and create a resilient, future-ready system, utilities are turning to AMI.





AMI isn't just a technology; it's a 20-year generational investment in the future of both communities and utilities.



By delivering real-time, accurate water usage data, AMI empowers utilities to enhance operational efficiency, improve billing accuracy, proactively detect leaks, and optimize processes through remote meter reading and reduced truck rolls. Beyond these operational benefits, AMI fosters a deeper connection with customers, building trust and improving service.

This guide will provide a concise, actionable five-step roadmap for AMI selection, offering practical insights, critical considerations, and a clear framework to unlock the long-term benefits of AMI technology.

Understanding its transformative potential will help you make informed decisions that positively impact your utility and the communities you serve.

## Five steps for AMI selection

- 1** **People-First:** Assemble a cross-functional planning team
- 2** **Communications:** Choose the right network
- 3** **Operations model:** Simplify with managed services
- 4** **Meter strategy:** Understand the value of static state meters
- 5** **Intelligence:** Leverage data for operational and strategic insights

1

People-First:  
Assemble a cross-functional  
planning team

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To successfully adopt and deploy AMI, utilities should first assemble a cross-functional planning team that represents all critical project roles. It is recommended that the utility includes a representative from each of the following departments:

### Overview of core AMI planning team by function

Function	Relevance and Value
Asset management	Insight into assets, vehicle fleet, and other physical resources
Billing	Ability to evaluate the need to upgrade billing software; train staff on utilizing AMI data for billing
Communications	To communicate change, value, and impact internally and externally to specific constituents
Customer service	Update response processes considering AMI data in managing customer inquiries, complaints, and proactive outreach
Executive leadership/public works director	Ensure AMI aligns with high-level business goals
Field operations/distribution	Knowledge of the water distribution piping, pressure requirements, and water quality issues; understanding of related equipment such as pumps, control valves, etc; insight on leveraging system abilities
Finance	To evaluate the lifecycle costs of the proposed AMI solution over a 20-year period; help deliver actionable insights through financial modeling and budgeting
Information technology (IT)	Expertise in software, data, and systems integration – including cybersecurity
Metering operations	Expertise in water measurement, meter installation, and utility standards
Operations technology (OT)	Expertise in impact to field equipment and network operations
Regulatory compliance	Ensure AMI system and data complies with regulatory requirements and the capability to manage compliance
Resource procurement, Capital planning	Understanding AMI system impacts to both near-term purchase and resource demand, alongside longer-term forecasting and impact

Successful AMI deployment relies on collaboration across multiple stakeholders, as shown in the table above. Engaging these diverse stakeholders early ensures alignment and maximizes the value of AMI. For instance, local governments may wish to consider AMI in a smart city initiative or may have additional uses for the AMI solutions. A combination utility, one that includes multiple utility services – water, electric, gas – may find synergies in sharing AMI solution components to drive further efficiency and innovation.

## Key questions and why it's important

### Who will be in charge?

- Clear accountability supports excellent AMI rollouts
- AMI project manager can act as chief liaison

### What are our AMI goals and how will we track progress?

- Set goals for pre-deployment, deployment, and post-deployment
- Adopt benchmarks and reporting to ensure contractual, regulatory, and operational requirements are met

### How should we redeploy resources, human or otherwise?

- AMI management may require new roles and existing roles may need to evolve. Assets and vehicles used in current meter management may be redeployable

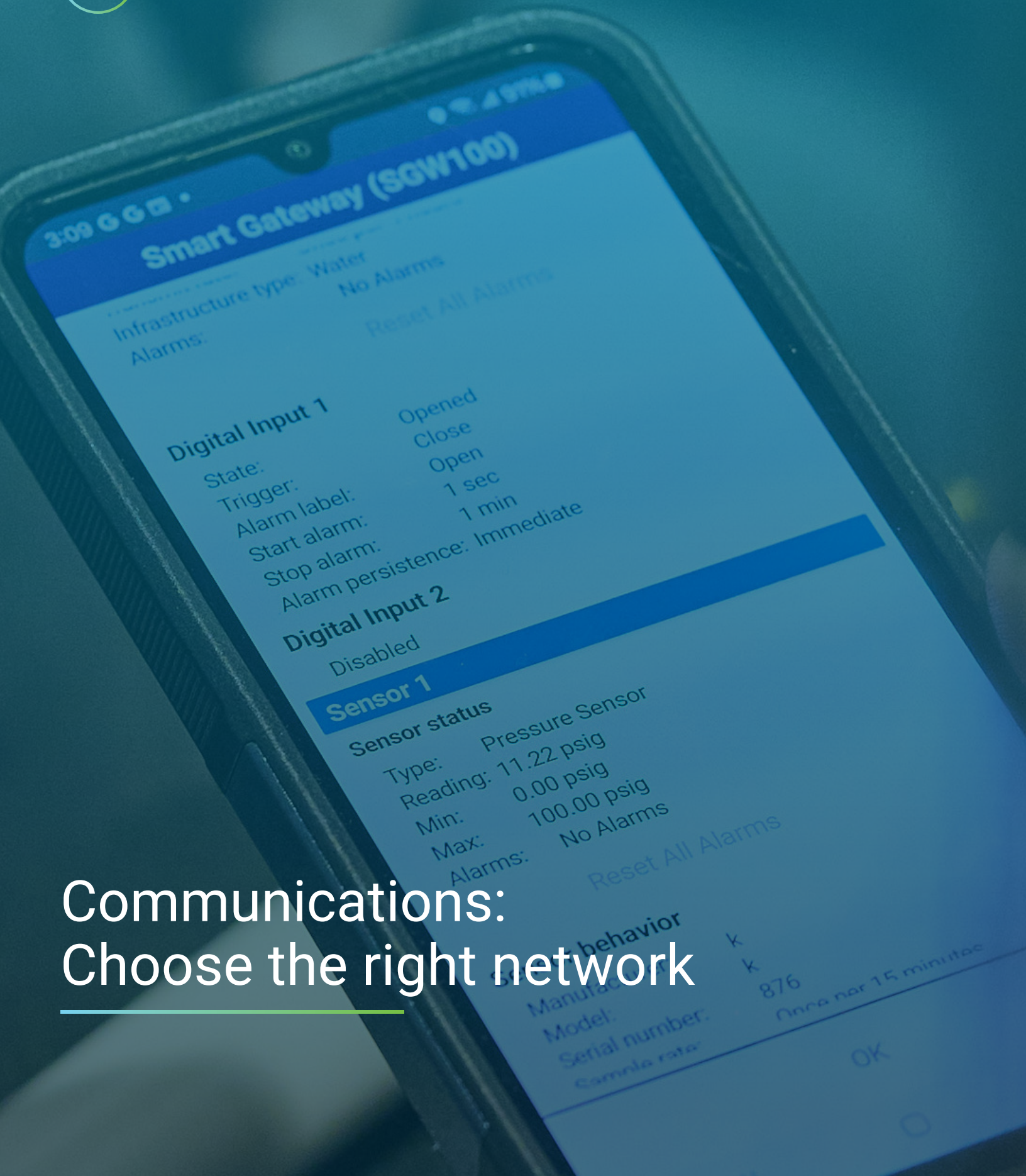
### How should we explain AMI to customers?

- Every utility needs to work to highlight and communicate customer benefits to manage expectations and timelines

### Which expectations should be clarified in AMI contracts?

- Network coverage, standard for read interval success (RIS), warranty requirements, and other accountabilities should be designed with vendors and contractors

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Communications:  
Choose the right network

With the rapid change of technology, choosing the right communications network is the most critical of all. After all, the communication network is the vehicle that ensures the smooth running of any smart network. **It's essential for utilities to choose a communications system that will be a long-term solution (20 years) that won't leave behind stranded assets or result in unexpected costs.**

There are four network options that define how utility communications work. Each network option brings different implications when reviewing them against key factors, which require close inspection from utilities to ensure they get the system they need.

#### AMI communications network options

1. Licensed RF (primary)
2. Licensed RF (secondary/shared)
3. Unlicensed RF
4. Cellular RF

## Network options: Key factors to review

- Security and reliability
- Dedicated frequency spectrum
- Coverage and signal quality
- Regulatory compliance and legal protection
- Cost-effectiveness and long-term sustainability
- Control

## 1 Licensed radio frequency (RF) primary considerations

Licensed RF primary frequencies offer reliable, secure, and efficient communications by ensuring exclusive access to a dedicated spectrum. Unlike public or shared networks, licensed frequencies never experience interference, leading to improved service quality, especially in critical applications.

Key benefits include:

- **Enhanced security and reliability:** Only authorized transmitters and receivers operate within the licensed frequency range, meaning capacity management is within the spectrum owner's control, eliminating unauthorized access and enabling encrypted, secure communications.
- **Dedicated frequency spectrum:** A dedicated frequency doesn't allow interference, resulting in clearer, more reliable communication with higher performance.
- **Improved coverage and signal quality:** Guaranteed access to a frequency allows for better deployment, improving coverage, especially in remote or challenging environments.

- **Regulatory compliance and legal protection:** Operating on a licensed frequency ensures adherence to strict regulations, providing legal protection in case of issues.
- **Cost-effectiveness and long-term sustainability:** Licensed networks offer scalable, long-term viability due to their efficient coverage and management.
- **Control and SLAs:** License holders maintain control over the frequency, network lifecycle, and scalability, avoiding reliance on third-party decisions and ensuring system growth is aligned with their needs. Licensed networks allow the operator the ability to provide contractually guaranteed service level agreements (SLAs).

**"Xylem's digital solutions improve our water management, make our community safer and enhance our customer service That's what it's all about."**

said Monty Ledbetter,  
director of utilities at the city of Hot Springs

## 2 Licensed RF secondary considerations

A secondary licensed user operates on a spectrum granted by a primary user, sharing bandwidth with third parties. While secondary networks retain some benefits of primary systems, such as security and reliability, these advantages are diminished due to the shared nature of the spectrum. Key limitations include:

- **Limited coverage and scalability:** Secondary networks are restricted by the unused capacity of the primary user, which limits coverage and growth potential since the primary user's needs take priority.
- **Loss of control and sustainability:** Operating as a secondary user means reduced control over network management, making it harder to ensure long-term sustainability and scalability.

In essence, while secondary licensed RF networks offer some advantages, they are constrained by the needs and priorities of the primary user, making them less flexible and reliable for large-scale, long-term deployment.

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“We appreciate that our team has direct visibility into our data. The level of transparency ultimately empowers our customers to take control of their bills and become active participants in managing their water usage.”

Sally Mohr, advanced metering infrastructure (AMI) program delivery director for Tacoma Public Utilities

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## 3 Unlicensed RF considerations

Unlicensed RF communication networks, including technologies like WLAN, Bluetooth, ZigBee, LoRa, and Amazon Sidewalk operate on open-access frequency bands, allowing anyone to use the spectrum without a formal license. These networks are convenient and widely used but come with several challenges. Key limitations and considerations include:

- **Interference and congestion:** Unlicensed networks have limited throughput due to device contention and interference. Since multiple devices can operate on the same unlicensed bands, interference is a growing concern, impacting network reliability and performance.
- **Security vulnerabilities:** Without strong encryption, unlicensed networks are more susceptible to eavesdropping and unauthorized access. Additionally, unlicensed network jammers can intentionally disrupt communications, posing further security risks.
- **Control:** Unlicensed RF systems often rely on private or consumer networks to convey data, ceding control of data pathways to third parties.
- **Limited range and coverage:** Physical obstacles like buildings and other environmental factors can significantly weaken signals, making it difficult to maintain reliable communication, especially at higher frequencies. This requires device positioning much closer to collectors, as compared to licensed RF networks, which then requires further investment in a greater number of collectors to ensure operations.
- **Basic equipment and limited customization:** Unlicensed networks often use off-the-shelf devices with minimal configuration changes, limiting optimization and the ability to evolve the system to next-gen standards beyond AMI.
- **Guarantees and warranties:** While radio solutions can be affordable from a capital expenditure perspective, they often lack guarantees on lifespan or performance on an unlicensed network.

Unlicensed RF networks offer flexibility and accessibility, but they come with trade-offs in terms of security, reliability, and coverage, making them less suitable for mission-critical or high-performance applications.

## 4 Cellular RF considerations

When comparing cellular RF systems to primary licensed RF systems, several key differences stand out, particularly in terms of spectrum allocation, interference management, equipment costs, and operational control.

- **Spectrum allocation and interference management:** Cellular RF systems operate within licensed frequency bands managed by mobile network operators (MNOs) like AT&T and Verizon. While this licensing helps minimize interference from outside sources, users are still dependent on MNOs' network configurations. Changes in network standards or the decommissioning of older networks (such as 2G and 3G) may require hardware upgrades for devices reliant on these networks.
- **Equipment costs and operational control:** Using existing cellular infrastructure can lower initial setup costs, but there are typically higher recurring subscription fees that overcome these initial savings in a relatively short period of time.

Additionally, users have limited control over network maintenance and configurations, as they rely on MNOs to ensure service quality and coverage.

- **Security considerations:** Cellular transmissions occur over public networks, which may expose data to security risks. To safeguard against unauthorized access, it's essential to implement strong encryption and security protocols.
- **Adaptability to technological changes:** Because cellular RF systems depend on MNOs, users must adapt to technological advancements and network upgrades, which could render existing devices obsolete and require additional investments.

There are many factors to consider when selecting the right AMI communications network for your utility. The key to ensuring the lasting success of your AMI solution is to choose a network that can scale to accommodate the growth of your utility and the increasing demand for smart, connected devices.

### Key questions for AMI communications network selection

#### Is the network shared, licensed, or primary licensed?

- How many other entities use your network impacts daily performance and long-term viability
- Non-primary networks are subject to the priorities of the licensee
- Utility data and long-term use can be deprioritized in favor of other uses, such as consumers

#### Can you control the noise floor within your wireless network?

- Noise is the biggest factor in determining network range and reliability
- Noise can severely limit read interval success (RIS) and reduce the efficiency of the meter-to-cash process

#### Does your network have reliable two-way communication?

- Two-way communications improve customer service and ability to perform on-demand remote reads
- Impacts ability to fully open, fully close, or throttle service remotely
- Determines the efficiency of over-the-air (OTA) upgrades to field services

#### Does your network deliver prioritized, immediate notifications via smart alarms?

- Channelization provides traffic control for OTA messaging
- Includes prioritization of critical alarms and data
- Impact latent of smart alarms related to leaks, bursts, etc.

#### What capability does your network have to grow with your needs?

- AMI is a long-term investment that needs flexibility and scalability

3

# Operations Model: Simplify with managed services

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US DOT 513562

AMI deployment has traditionally involved utilities managing their own networks. However, with modern AMI solutions, utilities now have the option to embrace end-to-end managed services for both software and infrastructure. These services provide enhanced reliability and predictable costs, freeing up internal resources and allowing utilities to focus on core functions.

Two common managed services for AMI deployments are:

**Software as a Service (SaaS):**

- **Key benefits:** Cloud-based SaaS solutions offer ease of ownership, enhanced cybersecurity, and predictable costs. Many AMI vendors, such as Xylem’s Sensus, offer fully managed SaaS plans that cover software, hardware, updates and maintenance, and analytics—all for a fixed periodic fee.

**Network as a Service (NaaS):**

- **Key benefits:** NaaS allows utilities to offload the management and maintenance of their communication networks to AMI partners, a low-risk option ensuring peak performance 24/7. This service is scalable and provides full coverage across the service territory.

## What’s right for you?

A combination of SaaS and NaaS offers an efficient, cost-effective solution for utilities looking to modernize their operations and improve service reliability. **Managed services allow AMI providers to do what they do best – precise measurement, communications, software, and cybersecurity – and allow water utilities to do what they do best: manage water resources.** Utilities can streamline their AMI systems, all while benefiting from predictable costs.

## Flexibility in FlexNet Ownership Options

Comparing ownership models between FlexNet NaaS and SaaS

	NaaS	SaaS
	OpEx Only	OpEx & CapEx
Financial planning		
Endpoint ownership, maintenance, updates	■	■
Endpoint software and firmware updates	●	■
Base Station ownership	●	■
Base Station maintenance and updates	●	■
Network management, monitoring, optimization, and security	●	■
Head End software licensing, ownership, monitoring, maintenance, patches, upgrades, and security	●	●
Upgrades and third-party software licenses	●	●
Backhaul administration, security, maintenance, and monitoring	●	■

4

Meter Strategy:  
Understand the value of static  
state meters

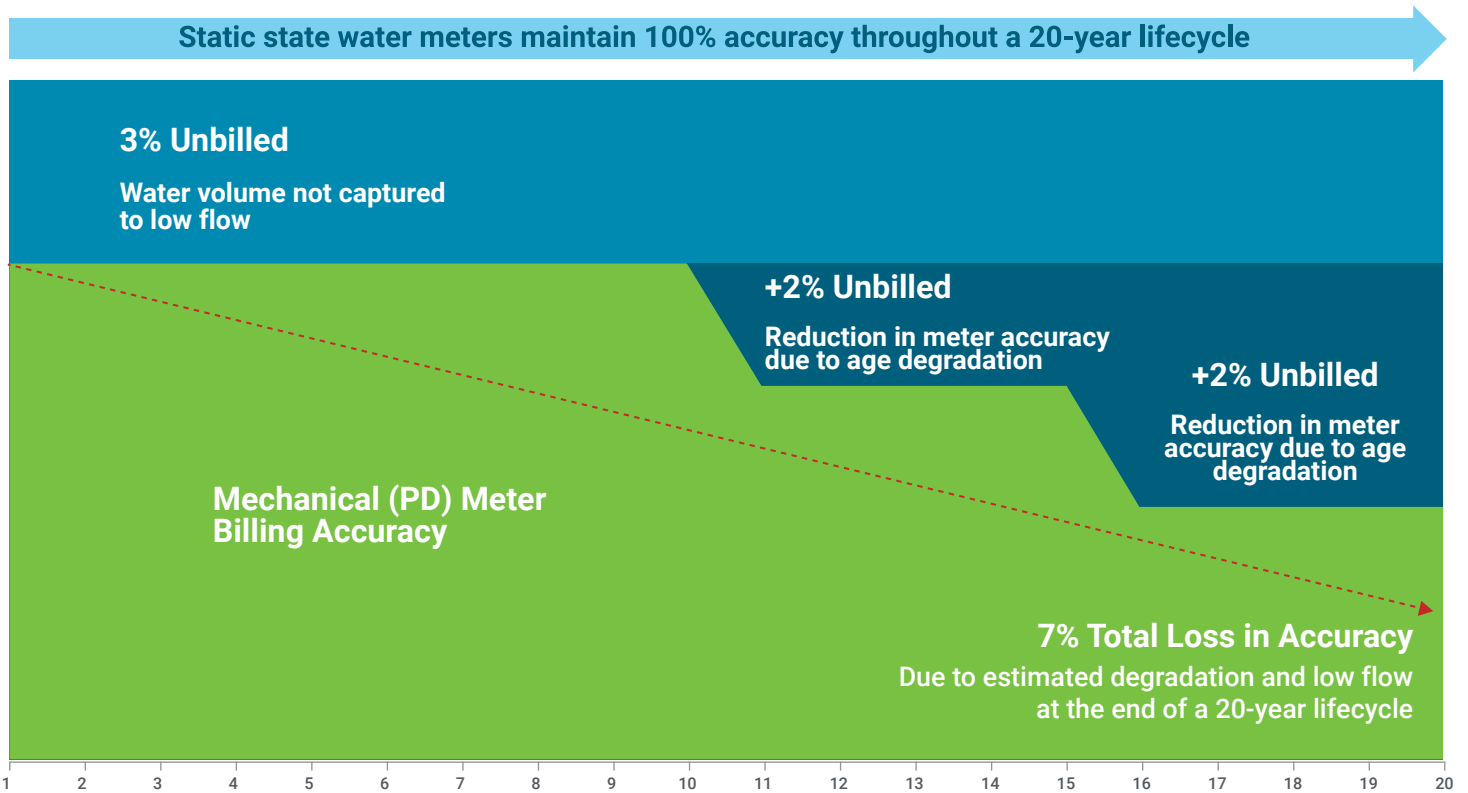
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A key decision in AMI deployment is whether to upgrade from mechanical meters to static state meters, and the order and priority with which the utility makes the changes. This decision hinges on utility investment budgets and the age and condition of your existing meter assets. Getting this decision right is critical due to its direct impact on future billing accuracy and revenue generation.

## Mechanical vs. static state meters

Mechanical meters are prone to inaccuracies, with performance declining 3% to 5% over their 15- to 20-year lifespan due to wear and environmental factors. Mechanical meters also struggle to capture low-flow usage, potentially missing up to six gallons of water consumption per day—about 3% of average daily use.

## Static State Meter Accuracy vs Mechanical Meter Degradation



Note: This illustrative model uses a benchmark of 3% losses due to technical challenges at low flow of a positive displacement meter. AWWA Accuracy Limits for Compliance with Guidelines used a benchmark to establish a 4% degradation over 20-year lifespan within a total allowance of 10%.

# Investing in static meter technology delivers a strong potential for lost revenue recovery and savings in water supply costs.

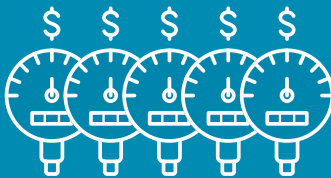
## Static meters offer significant advantages:

- **Enhanced accuracy:** Static meters provide precise, real-time water usage data, ensuring accurate billing and maximizing revenue with a current industry average of 15- or 20-year accuracy guarantees. Additionally, static state meters begin recording water consumption at lower flows, which further enhances billing accuracy and reduces non-revenue water.
- **Cost considerations:** While static meters have a higher initial cost, the long-term savings—especially from reduced maintenance, improved billing accuracy, and water conservation—far outweigh the upfront investment. Should a mechanical meter be upgraded through the purchase of a communicating register, the full capital cost is quite similar, but without the savings and benefits that static state meters bring.
- **Operational efficiency:** AMI-enabled static meters save utilities up to 30% in operational costs by eliminating manual meter readings and maintenance. Radios provide a degree of compatibility across brands, making it easier to incorporate various assets into an AMI solution.
- **Smart functionality:** Static meters can provide alarms, pressure and temperature monitoring capabilities, and remote full shutoff, turn on, and reduced flow. Upgrading to static meters is a smart investment that improves billing accuracy, enhances operational efficiency, and fosters better water conservation. Some utilities may prioritize AMI rollouts for their commercial and industrial (C&I) meters to first focus on a smaller number of customers that account for much larger volumes of water and revenue for a utility to recoup.

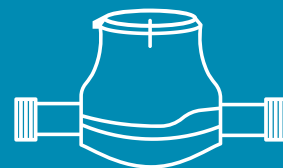
## In many cases...



The revenue loss from **one mechanical meter** over a 20-year lifespan....



...is **4 to 5x greater** than the initial meter investment itself.



Invest in **1 static state meter** that retains full accuracy throughout a **20-year lifespan**.

Utilities should consider advanced, static state meters as part of their strategy for sustainability. Choosing meters that only meet basic operational needs and the lowest capital costs can lead to significant long-term financial challenges. Instead, investing in meters that are economically and financially sustainable is essential for effective long-term planning.

Utility investment decisions should align with key performance goals, including regulatory compliance, customer satisfaction, service delivery, and environmental impact. Static meters are particularly suited for residential, commercial, and industrial use, addressing water wastage across all sectors—a concern of both local and global importance. Many utilities worldwide are already adopting this innovative approach.



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Intelligence:  
Leverage data for operational  
and strategic insights

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AMI impacts utilities in areas like data storage, management, analytics, and cybersecurity. Addressing these aspects upfront ensures smooth deployment and operations.

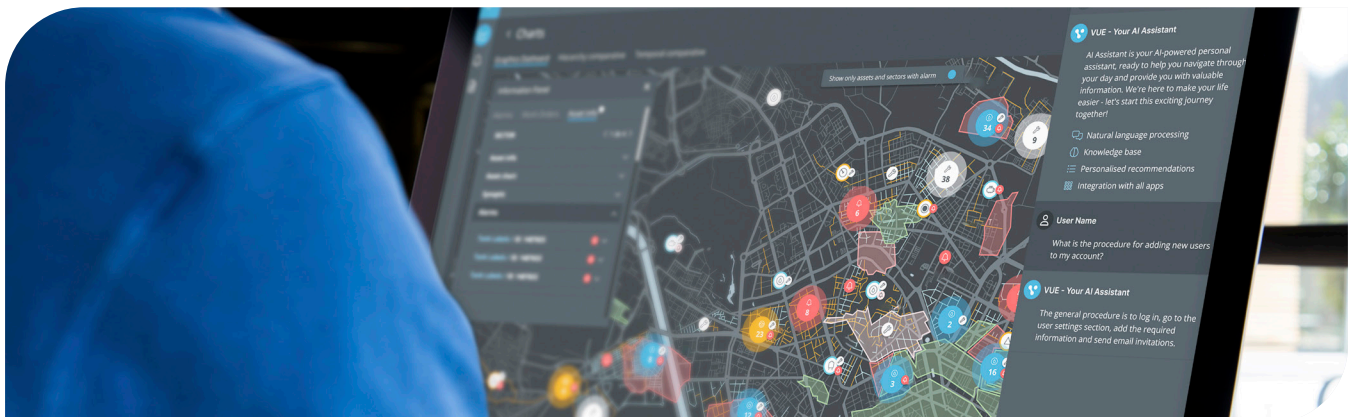
As the saying goes, “measure twice, cut once.” Similarly, involving IT and the core AMI planning team early ensures systems are prepared for AMI integration. Even with vendor support, IT and the team remain crucial for system integration and equipping the workforce with necessary tools.

During deployment planning, IT should help develop specifications to maximize AMI’s value by integrating it with other IT and OT systems like automated work dispatch, asset management, workforce management, geographic information systems and advanced analytics, such as digital twins.

## Key focus areas:

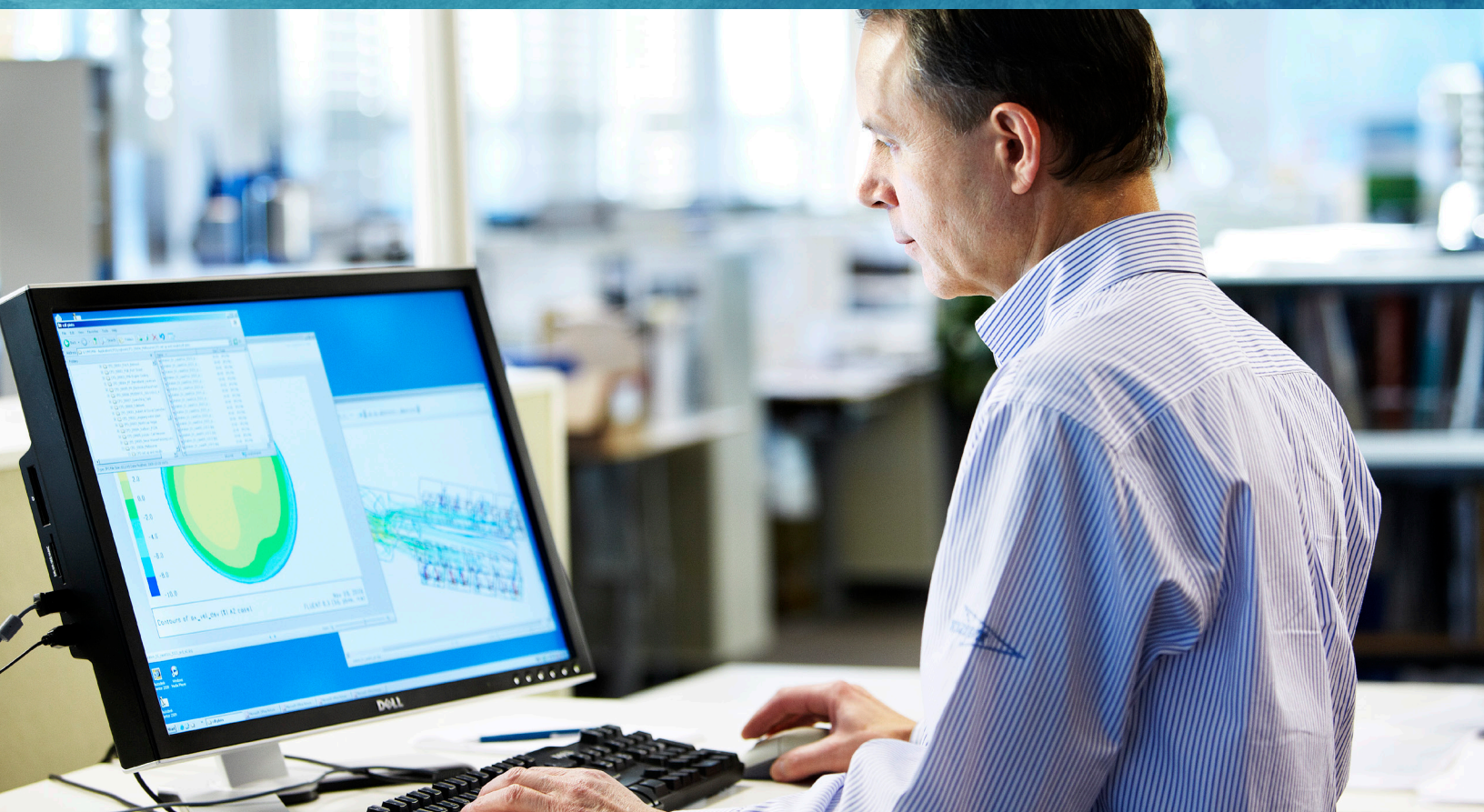
- **Cybersecurity:** Protecting utility and customer data is vital. Choose vendors with proven cybersecurity expertise to safeguard infrastructure and ensure data privacy.
- **Head-end software and data storage:** Cloud-hosted solutions simplify cybersecurity, upgrades, and maintenance while reducing server costs. Scalable cloud storage eliminates hardware expansion needs and enables cost-effective, future-ready operations.
- **Analytics:** Scalable, customizable analytics unlock AMI data’s potential. Systems must be capable of adapting to evolving needs, and enabling data-driven decisions and efficiency improvements.
- **Workforce tools:** Provide hardware (computers, mobile devices) and software (apps, dashboards) that integrate with platforms like iOS, Android, and Windows to boost adoption and streamline AMI use across the water utility.
- **System integration:** Ensure seamless integration with billing, meter data management, and customer service platforms. Vendors should offer adaptable systems to reduce costs when future upgrades are made and technologies are introduced.
- **System management:** Many utilities lack resources and budget for critical digital configuration, monitoring, and maintenance and troubleshooting functions. Consider outsourcing these system management needs to vendors or third-party services that can prevent unplanned costs and ensure smooth operations. Outsourcing can help avoid unplanned expenses while ensuring the system operates smoothly.

Xylem Vue’s full suite of digital solutions integrates and manages data from any source in a single platform for a complete view of your water and wastewater network.



# Conclusion

AMI is a generational investment in the future of our water systems and can help tackle critical utility issues, including rising costs and aging infrastructure, as well as the demand for enhanced customer experiences. Water utilities can rise to meet these challenges through the implementation of AMI, but success depends on careful planning and selecting the right solution. This guidebook can help you navigate those decisions to find long-term, sustainable success. By embracing AMI, we can create smarter, more resilient water systems that are ready for the future.



# Expected outcomes and benefits of a successful AMI rollout

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## Environmental

- ✓ Decreased carbon footprint and fuel consumption (reduced truck rolls)
  - ✓ Reduced water loss
  - ✓ Enhanced water production efficiency by minimizing power and chemical usage
  - ✓ Decreased overall water demand through efficient use and leak detection
  - ✓ Platforms to visualize and optimize water quality across the water system
  - ✓ Power to leverage water usage data for other departments, including wastewater for management of inflow and infiltration (I&I)
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## Social

- ✓ Enhanced employee well-being
  - ✓ Expanded professional development opportunities
  - ✓ Strategic communication and public outreach to build community trust
  - ✓ Data to improve affordability programs for disadvantaged customers
  - ✓ Enhanced service quality and customer satisfaction
  - ✓ Proactive customer education initiatives
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## Safety

- ✓ Decreased physical strain on employees creates safer work environments
  - ✓ Minimized exposure to hazards (e.g., aggressive pets, traffic, adverse weather)
  - ✓ Less frequent need for private property access
  - ✓ Continuous remote monitoring for improved hazard management
  - ✓ Enhanced water quality monitoring
- 

## Customer

- ✓ Supports affordability efforts
  - ✓ Near real-time, on-property leak detection
  - ✓ Enhanced ability to conserve water and save money
  - ✓ More accurate meter reads and bills
  - ✓ Near real-time water usage data
  - ✓ Proactive and enhanced customer service with meter alarms
  - ✓ On-demand reads to troubleshoot customer concerns
  - ✓ Reduced accidents in the field and in the community
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# Appendix

## Getting started

Based on the five steps outlined in this guidebook, here are some suggested actions to get the process started:

### People

- **Identify key stakeholders:** Determine who will be impacted by or involved in the project. Ensure alignment and commitment to the project's success.
- **Assign a project manager:** Identify a project manager and create a planning team with representatives from necessary departments to oversee, make decisions, and ensure accountability throughout the project's lifecycle.
- **Plan training programs:** Develop training for employees interacting with the AMI system (e.g., meter readers, customer service, technicians) to build internal capabilities for operation, management, and maintenance.

### Process

- **Set clear objectives:** Define measurable goals for the AMI project (e.g., improved billing accuracy, reduced costs, enhanced customer service) to keep the scope focused and aligned with desired outcomes.
- **Create a project timeline:** Establish a timeline with milestones, budget estimates, and key deliverables to ensure a structured approach with clear phases (pilot, full deployment, post-implementation review).
- **Assess current infrastructure:** Evaluate existing systems to determine AMI requirements (e.g., meter types, communication networks, data analytics, and software) to understand current operations, challenges, and desired outcomes.
- **Develop a communication strategy:** Create a plan to regularly update both internal teams and customers about progress and changes, ensuring transparency and managing expectations.

### Technology

- **Research AMI systems:** Evaluate AMI system options based on factors like existing infrastructure, scalability, security, and data analysis capabilities to ensure success in real-time data collection, reporting, and analysis.
- **Plan for data collection and security:** Develop a strategy for collecting, storing, and securing data, addressing privacy concerns and regulatory compliance.
- **Ensure infrastructure compatibility:** Confirm that both current and any planned infrastructure investments will support the selected AMI technology and integrate with existing systems (e.g., billing and customer management).
- **Start a pilot program:** Run a pilot with a small subset of customers or a specific service area to identify challenges early on and refine the system to meet desired outcomes.

### About Sensus

Xylem's Sensus provides remotely managed products and solutions that deliver the right data at the right time for investor-owned utilities, cooperatives and municipalities. As part of Xylem's digital portfolio, our smart devices connect with a variety of communication technologies to help customers make timely decisions that optimize electric, gas and water systems. [Learn more at xylem.com/sensus.](https://www.xylem.com/sensus)

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