QUANTA TECHNOLOGY

Smart Meters and Grid Modernization

Guide to a Successful AMI Implementation

a Quanta Technology white paper by

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In this White Paper

Introduction

The demands on the power grid in the 21st century are rapidly changing. Many utilities are looking to grid modernization plans to meet these challenges. Grid modernization is not a series of individual technologies but a prioritization of investments that create a portfolio of technologies to meet the utility's vision. These technologies may require integration as well as new processes and trained staff to manage them. A major component of many plans is smart meters that make up an advanced metering infrastructure (AMI) system. To be a successful component of a plan, care must be taken in the planning, process development, implementation, and integration of the AMI system to ensure the utility's goals and vision are met.

As of 2018, over 150 million smart meters have been deployed in the U.S. with a penetration rate of over 55% [1]. While slightly more than half of US utilities have already deployed AMI systems, others have plans in the works to deploy. However, many of the currently deployed systems were purchased in isolation, specifically to improve meter reading efficiency and accuracy, or to support new rates. While these remain important benefits, AMI has become a foundational technology enabling much broader grid modernization use cases outside of the historical meter-to-cash drivers. Failing to consider AMI as part of a comprehensive grid modernization strategy can result in under-utilization of the system's potential, or worse, a system that can't meet the utility's goals and vision. Today we see growing interest in expanding the capabilities of existing AMI deployments and the need for more comprehensive planning and deployment strategies for new AMI projects to support the utility's vision. A successful AMI implementation should not be considered as a mere standalone technology choice but as part of an overall strategy. It is a substantial long-term investment for any utility, so it has to be done right!

While a comprehensive grid modernization strategy may seem like an overwhelming task, proven methodologies exist that can be applied to break it down into manageable steps and ensure a successful result. This paper provides an overview of the relationship between smart meters, AMI systems, and grid modernization as a whole and provides a methodology to successfully implement an AMI system that meets the current needs and future goals of a utility. A four-step approach to AMI system implementation (planning, vendor selection, implementation, analytics) is presented that will allow a utility to move from planning to implementation with the overall grid modernization plan in mind.

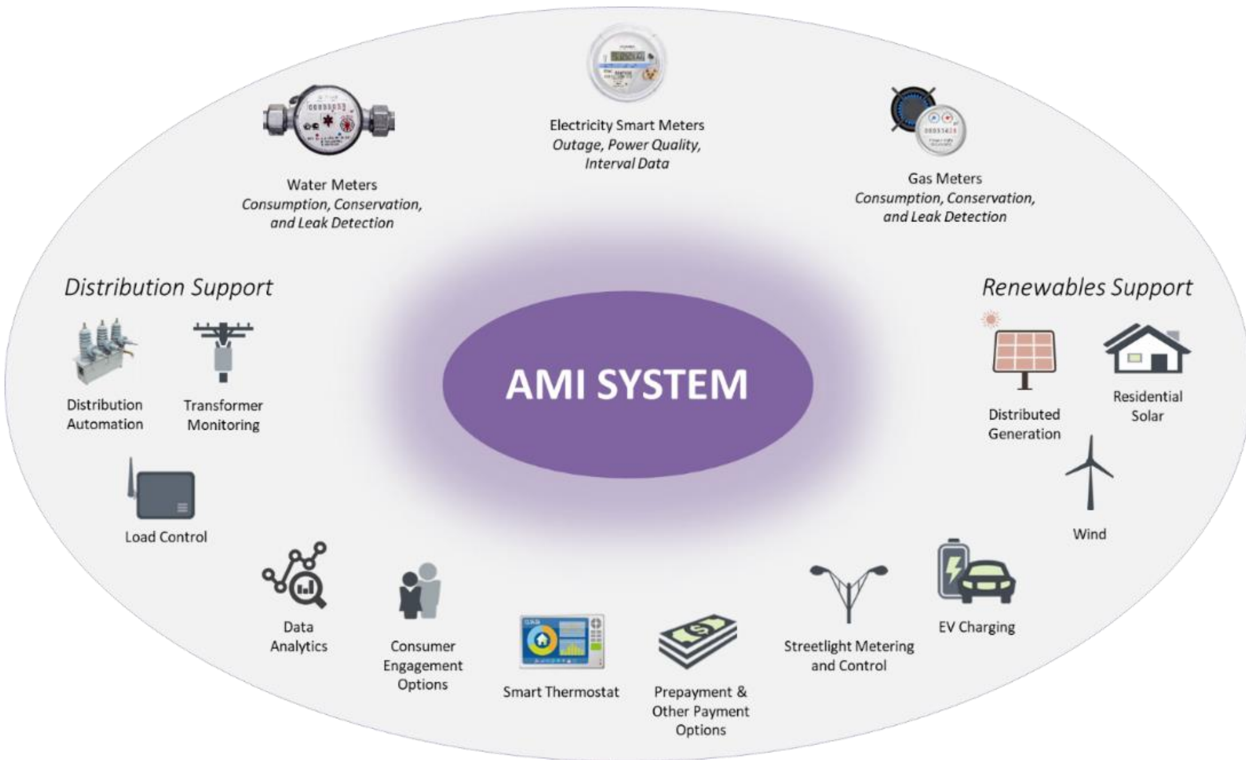

Figure 1. The Potential of AMI

Overview of AMI Systems

An AMI implementation program would implement a two-way remote meter reading capability that includes the smart meters, field communications, other edge devices, and the system head-end that interfaces to other systems such as billing, outage management, etc. (Figure 2 presents a functional overview of an AMI system.) As metering systems have evolved from manual read systems to drive-by systems to fully integrated two-way systems, this has driven several changes in what the metering systems can do (see Meter Evolution "sidebar" following this section for additional information). Smart meters have functionality such as load, demand, and voltage profiling that was previously only available for large commercial and industrial (C&I) customers but is now available at every metering point. With two-way communications, an AMI system can provide additional information on outages, voltage, loading losses, etc., which can be of tremendous benefit to the utility and the end customer. Such programs enable a broad range of capabilities that result in utility cost savings and customer satisfaction improvements by providing the ability to offer more granular consumption data and power quality information, as well as outage notification, water leak detection, and remote connect/disconnect. Hence, AMI is a key modernization program and enabler of advanced functionality in other systems such as customer information systems (CIS), outage management systems (OMS), and advanced distribution management systems (ADMS). As such, AMI programs are seen as top-priority foundational programs due to a large number of related and dependent programs, as well as the savings and customer benefits they make immediately available.

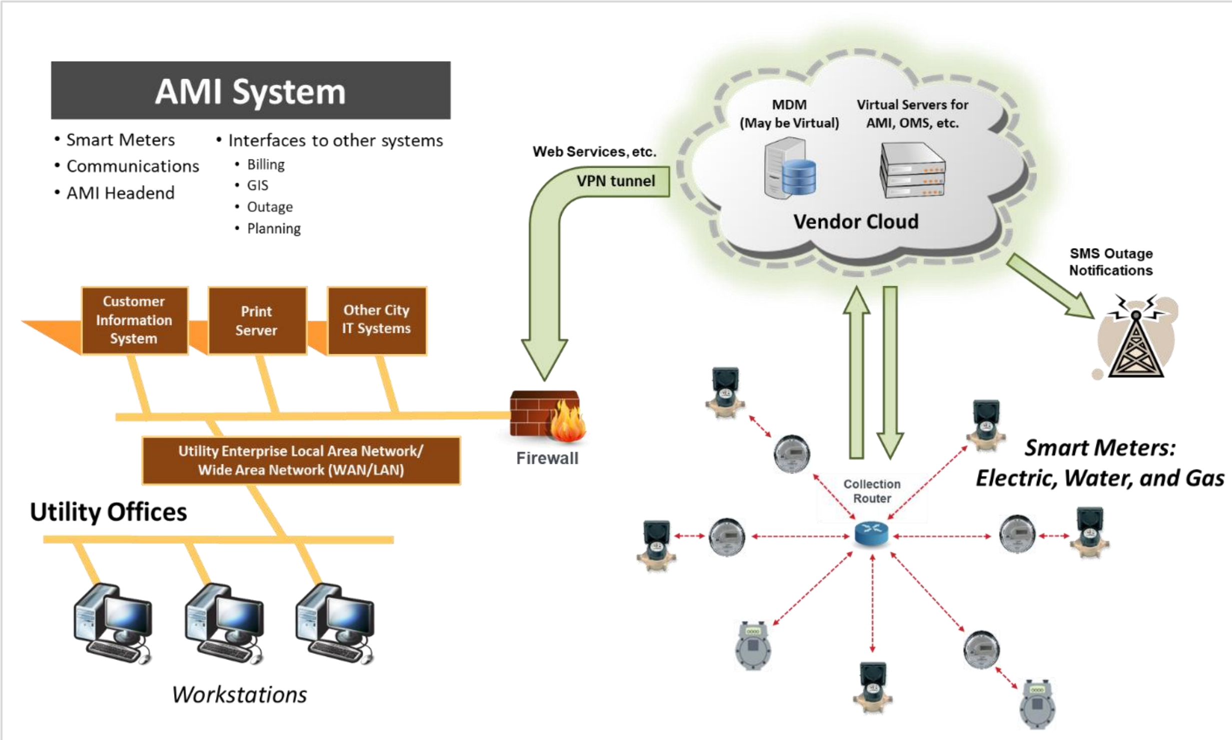

Figure 2. AMI System Overview

AMI Architectures

There are many different communications architectures in current AMI systems, and while these include some very expensive implementations like "fiber to the meter", the two dominant architectures typically utilized are the "star" (a.k.a. point-to-multipoint) and "mesh" (a.k.a. peer-to-peer) architectures (see Figure 3). The star implementation generally has multiple elevated base stations that communicate directly to field devices. In some cases, battery-powered devices such as gas and water meters communicate through an adjacent electric meter, but direct communications to and from these devices and the base station are usually possible. In a mesh architecture, electric meters register to the collector take-out-point – either directly if they have a strong enough radio frequency (RF) signal or through a peer electric meter that has a good signal. These systems usually require that battery-powered devices communicate through an electric meter or a repeater installed specifically for this purpose.

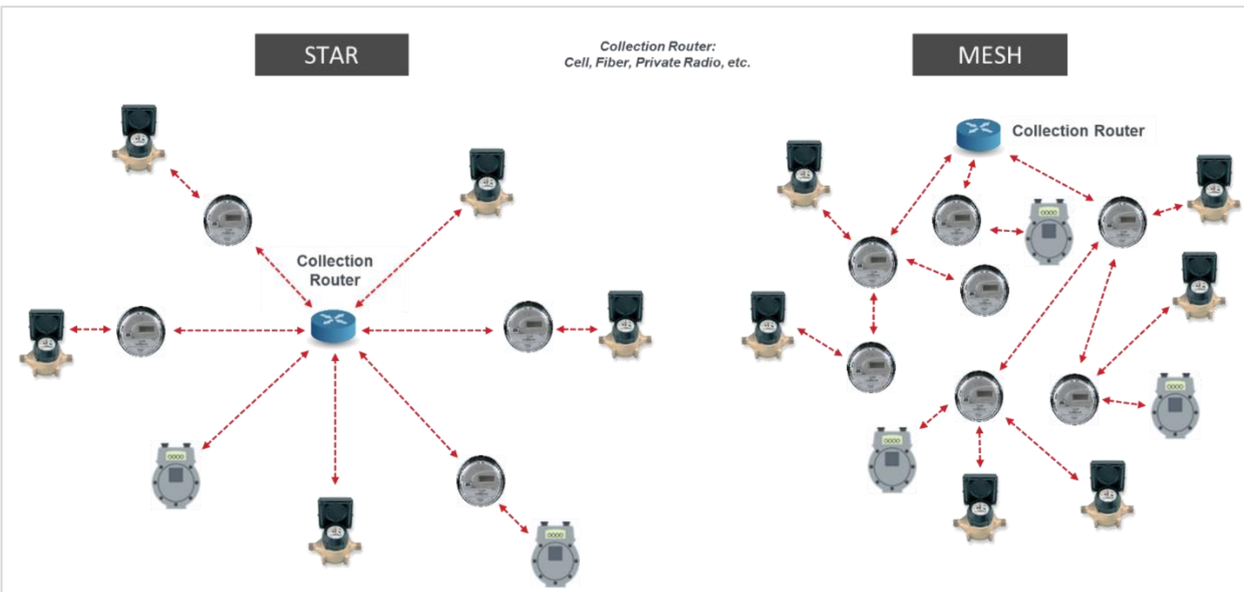

Figure 3. Dominant AMI Architectures

There are advantages to each type of architecture. For dense deployments where the electric, gas, and water service areas almost completely overlap, mesh implementations can lead to lower deployment costs since there might be little-to-no network-specific equipment other than meters. For low-density deployments or deployments with significant gas and/or water-only service territory, the star approach can be more attractive as it tends to be simpler to implement and operate. Of course, these are very general distinctions, and many other considerations can influence architecture selection. Ultimately, the physical constraints and desired functionality must be considered when selecting an AMI system.

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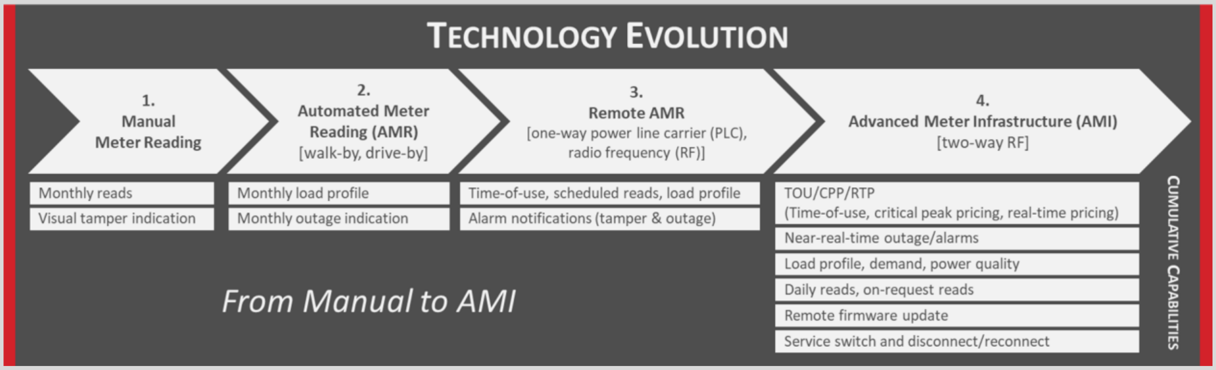
SIDEBAR: The Evolution of Meters to Smart Meters/AMI Systems



Over the past decades, meters have evolved from devices whose primary function was to provide information for billing to being part of an AMI system that forms a foundational component for grid modernization. This evolution can best be described in four main stages:

Stage 1 of this evolution is manual meter reading (MMR). Still in use at some utilities (particularly gas-and/or water-only), MMR requires a reader to be on the premises, generally on foot. The approaches and technologies vary from relatively basic (a technician, a “route book”, and a pen) to relatively advanced (extracted via handheld electronic reader or paper tape, sometimes including limited load profile data).

Stage 2 of this evolution is automated meter reading (AMR). This implementation typically involves loading a route into a mobile or handheld reader that collects the data when the device is near enough to the radio frequency (RF)-based meter to receive the transmitted data. Because the data can be received by simply walking or driving by the meters, fewer meter readers are required and the automated process essentially eliminates human error and the need for re-reads. Cost savings in this stage have been realized through improved accuracy and efficiency. Beyond RF-based meters, some higher-end commercial and industrial accounts during this stage used modems to transfer data, often to complex billing systems such as the Itron MV-90 system.

Stage 3 of this evolution is remote AMR. This involves one-way systems such as power line carrier (PLC) or RF technologies that provide reads that can be performed remotely. Some of these systems offer additional features such as scheduled automated reads, outage notification, load profile reads, and event alarms such as tamper notification. Such an implementation provided additional cost reductions by eliminating the vehicles and route drivers required for walk-by and drive-by reads.

Stage 4 of this evolution is AMI. This stage provides full two-way communications from the head-end system to the end-point meters typically via RF. (Some water and gas systems limit communications to conserve battery power and are not truly “full” two-way communication, but the communications topologies of the various systems are beyond the scope of this white paper.) As discussed in this paper, this full two-way high-speed communication enables a broad range of advanced grid modernization capabilities like remote connect/disconnect, remote firmware updates, and near-real-time alarms. Initially AMI was used primarily for meter reads and load profile data. As the technology has matured, many other functions are being utilized not only in billings but other distribution applications also.

Grid Modernization

Historically, a utility's primary goal has been to deliver reliable power to its customers. However, technical and societal drivers are changing the utility landscape. Grid modernization allows utilities to prepare the power delivery grid to address these drivers, which include the following [2]:

- Customers' evolving reliability and resilience expectations
- Increasing dependency of our digital economy on electric power
- Evolving weather patterns (e.g., more frequent and more severe storms and catastrophic events such as tornados and hurricanes
- Impacts of human events (e.g., sabotage, terrorism, etc.)
- Stress imposed on the existing grid by the adoption of new technologies such as distributed energy resources (DER) and transportation electrification
- Increased residential demand due to epidemic or pandemic events

Grid modernization enables key capabilities and features for a modern and future grid, including [3]:

- Greater RESILIENCE to hazards of all types
- Improved RELIABILITY for everyday operations
- Enhanced SECURITY from an increasing and evolving number of threats
- Additional long-term AFFORDABILITY to maintain our economic prosperity
- Superior FLEXIBILITY to respond to the variability and uncertainty of conditions including a range of energy futures
- Increased SUSTAINABILITY through energy-efficient and renewable resources

One of the key questions surrounding grid modernization is which investments will yield the greatest benefits. Grid modernization investments fall into three major technology categories: 1) advanced metering infrastructure (AMI), 2) power flow management, and 3) distribution and outage management [4]. Each category and relevant programs are outlined below:

1. AMI and Smart Meters
2. Power Flow Management
    a. Smart Inverters
    b. Volt/VAR Management
    c. Power Line Monitors
3. Distribution and Outage Management
    a. Distribution Management System (DMS)
    b. Outage Management System (OMS)
    c. Work Management System (WMS)
    d. Fault Location Isolation Service Restoration (FLISR) [5]
    e. Advanced Distribution Management System (ADMS)
    f. Distributed Energy Resources Management System (DERMS)

Utilities have begun to look at all the data available from these systems and how they may be able to improve grid performance. Data analytics can be applied to the different systems to improve asset management, outage and restoration management, and DER management, as well as provide near-real-time grid monitoring (Figure 4). However, it is important to note that the AMI system monitors the entire distribution grid and is an integral part of the other areas.

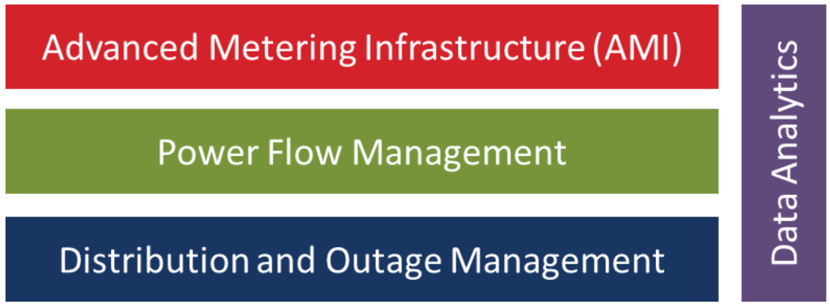


Figure 4. Grid Modernization Technology Categories

AMI and Grid Modernization

Providing utilities and their customers with higher-resolution consumption data and two-way communications, smart meters are the backbone of any advanced metering infrastructure (AMI) system. While this functionality is useful in its own right, as part of a well-designed AMI system, they become key supporting elements of a modern and future-ready grid. Figure 5 presents an overview of AMI's numerous possibilities when integrated as part of a well-designed grid modernization program. Smart meters and AMI systems have a very important role in grid modernization as it supports many of the programs at the heart of a modern grid (as well as modern gas and water delivery systems):

- Increased system monitoring
  - Outage identification, notification, and restoration
  - Water leaks
  - Usage alarms
- Improved operational efficiency
  - Fewer truck rolls
  - Reduced losses
- Increased reliability
  - Reduced time to outage detection and restoration
  - Improved system planning
  - Asset monitoring
- Support for new regulatory and policy requirements
  - New tariffs in support of electrification, renewables, and other initiatives
  - Conservation programs
- A communication canopy which other programs can utilize
  - Distribution automation
  - Demand response

As an AMI system covers every metering point and the entire distribution grid, it is a key component of grid modernization. For example, and AMI system can detect outages, detect abnormally high or low voltage conditions, help identify unregistered PV installations, assist in verifying load reduction in conservation programs, and many other functions. AMI is now an integral part of a grid modernization strategy. The information from an AMI system will require integration with ADMS or other software solutions that allow the data to be analyzed, visualized, and paired with other data for the utility's and customer's benefit.

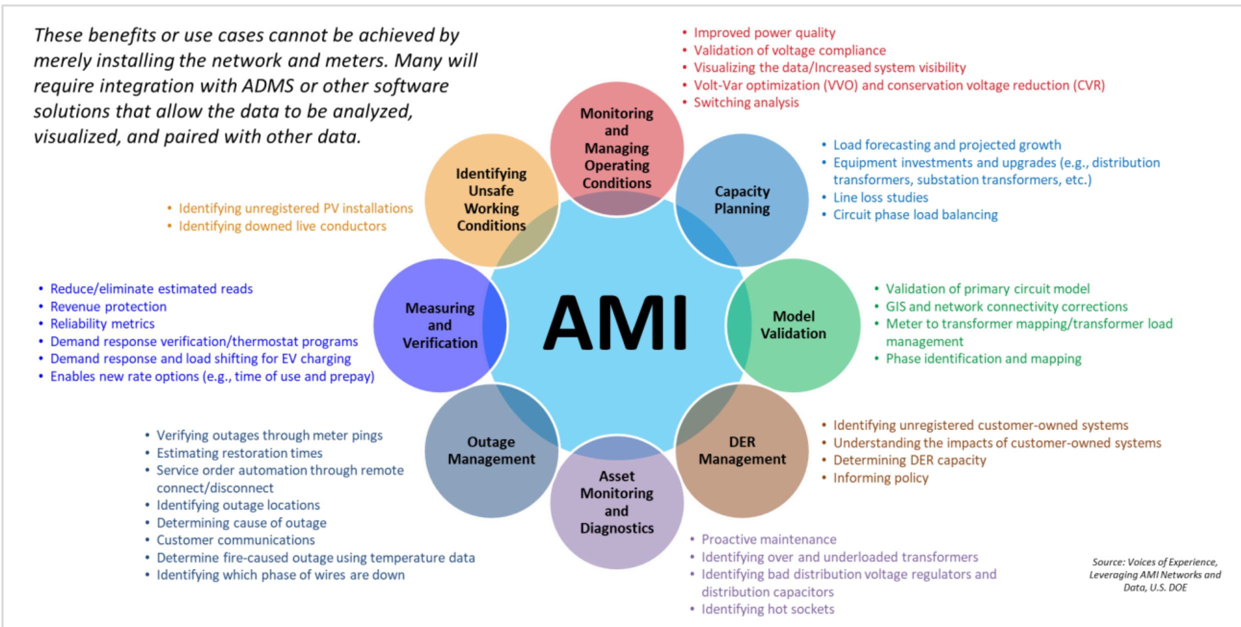


Figure 5. AMI and Grid Modernization

"Like most small cities that operate utilities, Newberry's elected officials are very much in tune with the sentiments of our customer base. Our staff presented the concept of automated metering infrastructure to our city commission as a means to address some deficiencies in meter reading. The city commission quickly realized the value in providing daily and hourly utility consumption data to our customers, and the opportunities it would provide in making decisions related to utility consumption. The commission directed staff to initiate a project to implement AMI technology in Newberry. Our team recognized the complexity of deploying AMI, and while all are experts in their area of operation, they wisely recommended that we partner with a third-party consultant to make sure we realized the benefit of a consultant's experience. We selected Quanta Technology after a thorough evaluation of several firms. Their expertise and experience in successful AMI deployment projects were key to their selection as our project partner."

Mike New | City Manager
City of Newberry, FL

Plan for a Successful AMI Implementation

A successful AMI implementation involves business, organization, and technical collaboration. One of the most critical factors for AMI project success is forming a cross-departmental project team with high levels of project buy-in. The Quanta Technology AMI team, over its years of AMI system implementation, has seen system deployments minimized or fail – not for technical reasons but rather due to a lack of support within the utility and/or community. It is important to understand how AMI system benefits can assist the utility in achieving its goals. In reviewing these benefits, it is important to prioritize which functions are most important to best develop an investment plan and timeline. The AMI system specification should be created with these objectives in mind. In reviewing the various AMI suppliers, it is important to consider certain physical parameters that may impact the system performance (electric, water, gas, or some combination of all, physical terrain, urban/rural density, etc.). Once the AMI supplier is chosen, it is critical to integrate the AMI systems with the other utility systems during, or preferably before the meter rollout. Consideration of these steps will increase the chances of a successful implementation and fully realizing the AMI system benefits.

Other important considerations are listed below. One that deserves special attention is community engagement. Absent community buy-in, serious problems can occur. It is best to engage the customers throughout the process.

Key considerations for a successful project include:

- A committed cross-departmental team
- A clear understanding of the objectives of the AMI deployment (use cases)
- Prioritization of AMI smart-grid features/functions to meet utility goals
- Consideration of future functionality
- Proper IT integration with legacy systems
- Best use of in-house versus outsourced (hosted AMI) resources
- Prepared staff (compare current processes to new processes required with an AMI system)
- Community engagement throughout the entire process
- Customized request for proposal (RFP) specification that covers a utility's priorities
- A suitable contract for AMI system deployment and acceptance
- Deployment plan and test plan

Figure 6 shows the approach that Quanta Technology has used successfully for AMI implementations in previous engagements. This approach is broken down into four phases: planning, vendor selection, implementation/deployment, and analytics.

While all of the steps are important to a successful AMI implementation, some of the key steps are outlined in the following sections.

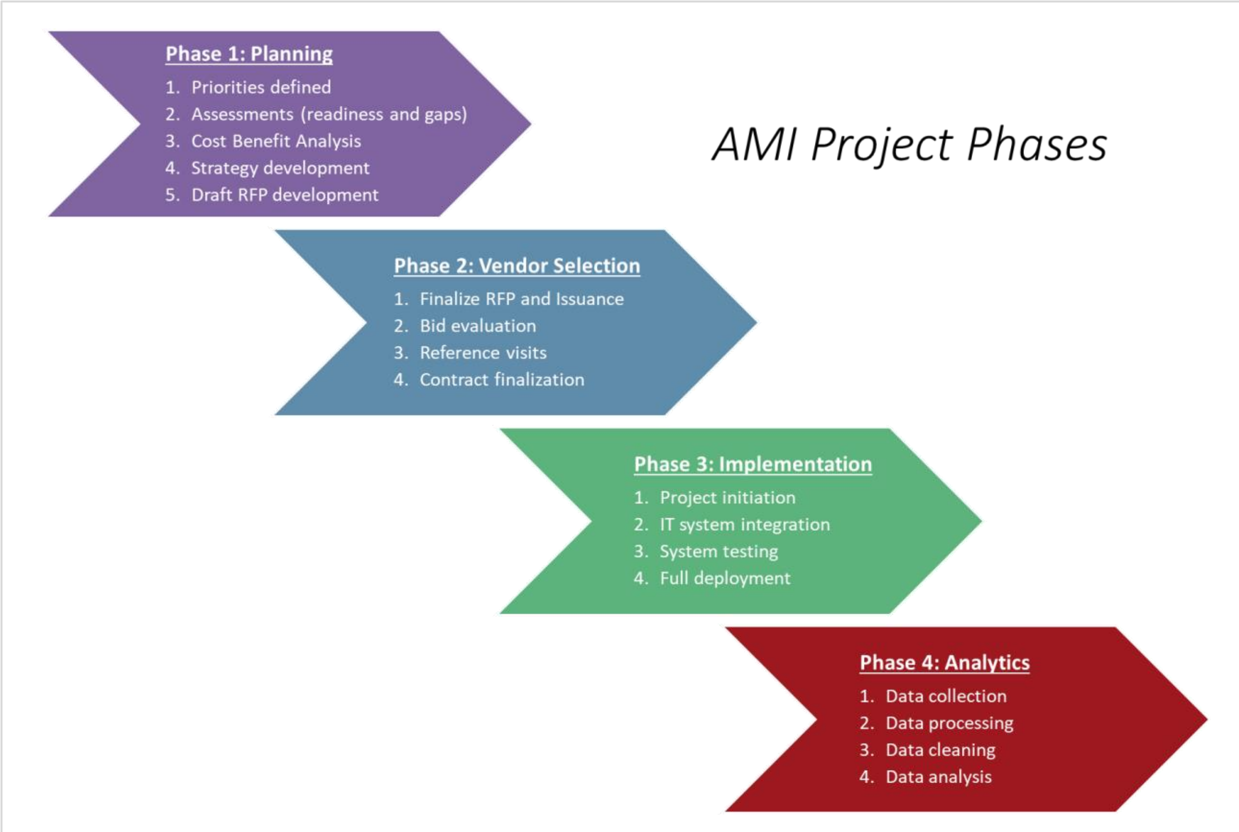


Figure 6. Phases of an AMI Project

Phase 1: Planning

Assessment (Readiness and Gaps)

Quanta Technology has found that a critical step in AMI system implementation at a utility is the thorough review and mapping of existing processes to help identify potential weaknesses and to help guide RFP planning. Some of the processes typically reviewed are presented in Figure 7. While gas processes are not listed in the figure, for a utility that serves gas, a similar list of processes should be developed, reviewed, and mapped. Also not shown are the new processes that do not currently exist at the utility that would be needed for an AMI implementation (e.g., customer opt-out, over-the-air [OTA] firmware updates, event management, etc.).

ELECTRIC	WATER
1. Calibration/testing	1. Calibration/testing
2. Meter repair/return process	2. Meter repair/return process
3. Periodic testing	3. Periodic testing
4. New installation	4. New installation
5. Replacement installation	5. Replacement installation
6. Indoor/outdoor installation considerations	6. Indoor/outdoor installation considerations
7. Meter configuration (net, LP, etc.)	7. Leak: customer-side
8. Stopped meter	8. Leak: city-side
9. Damaged meter	9. Leak: septic forgiveness
10. Tamper/theft disconnect	10. Bulk sales (temporary meter)
11. Meter error/event process	11. Stopped meter
12. Non-pay disconnect	12. Damaged meter
13. Move in/out service connect/disconnect	13. Tamper/theft disconnect
14. Billing name/address change	14. Non-pay disconnect
15. Billing dispute re-read	15. Move in/out service connect/disconnect
16. Read-to-billing process	16. Billing name/address change
17. Inventory process	17. Billing dispute re-read
18. Net metering	18. Read-to-billing process
19. Load control	19. Inventory process
20. Outage response	20. Inadvertent meter swap
21. Inadvertent meter swap	

Figure 7. AMI Process Review

Cost-Benefit Analysis

Based on the utility's vision and goals, a well planned and executed AMI system can help achieve many benefits. These benefits include the following:

- Use of net metering to enable more widespread adoption of solar or other renewables
- Improved customer satisfaction with customer web portal features such as:
    - Detailed views into electric and water usage during the month with at least hourly granularity
    - Flexible payment options including bill-date selection, different rates (time-of-use, demand, etc.), prepay, and levelized billing
    - Alternate rate comparison capability to allow customers to examine "what if" scenarios had they been on an alternate rate
    - Customer alerts and notifications based on budget and/or electric consumption targets, outages, leaks, etc.
    - Ability to schedule power reconnect/disconnect
    - Improved city outage response and restoration speed with detailed knowledge about location and extent of outages in near-real-time (each meter provides outage information to an OMS system for processing to determine the location)
- Promotes environmental responsibility by reducing truck rolls and enabling remote resolution to address customer concerns such as billing-read verification
- Tamper and theft notification
- Improves overall conservation with features such as:
    - Detailed customer electricity and water usage information to identify high electric or water usage in shorter timeframes before they become critical

- Identification of water leaks in shorter timeframes
  - Identification of system losses with system water balance and electric consumption analysis
- A communications canopy that other programs such as distribution automation can utilize

Many of the quantifiable benefits (hard savings) are shown in Table 1. This list includes specific items that should be used in a cost-benefit analysis. This list may be expanded for any utility based on other hard savings they might identify. Benefits that are harder to quantify (i.e., "soft" benefits) are also shown in Table 1. Although difficult to do, it is possible to quantify some benefits depending on the utility's decision to pursue a particular program (e.g., the employee safety line item). For instance, a utility could gather information on lost time and other expenses associated with accidents on customer premises related to meter reading. Many other soft benefits can be identified depending on each utility's drivers. For example, one might list improved environmental responsibility as a soft benefit of reduced truck rolls.

Table 1. AMI Cost-Benefit Analysis Topics

Hard Savings	Soft Benefits
Administrative cost reduction – bill-check/re-reads and estimates	Employee safety – Reduced on-customer-premises time
Elimination of route meter reading	Customer usage data and alerts
Less outage/restoration on-site time	Faster detection of theft
No on-site power quality checks	Faster notification of outage and restoration
Removal of on-site connect/disconnect	Faster notification of customer-side leaks
Reduced non-technical losses, electric	Better power quality monitoring – Voltage
Reduced non-technical losses, water	Enabler for future tariffs
Improved water revenue from replacing slow meters	Flexible billing dates (if CIS supports)
Improved electric revenue from replacing slow meters	Aggregated billing (if CIS supports)
Water leaks	Prepay option – Less deposit – Improved cash management
Vehicle costs/fuel reductions	Support for future grid modernization activities - Electrification/solar/load control
Overtime cost reduction for after-hours reconnects	
Rapid tamper detection – Revenue loss reduction	
Cash float – Shorter read-to-bill cycles	
Meter replacement recovery – Partial	
Reduced sewer forgiveness on service side leaks	
Water balance – Loss reduction	

What about water? Many utilities implement AMI systems without going through a cost-benefit analysis since the operational efficiencies and customer benefits are believed to be self-evident. However, Quanta Technology has been involved in benefit-cost analyses for utilities, and some surprising results have emerged. One of these surprising benefits is the value of an AMI system in identifying and localizing water leaks. Literature shows that municipal unaccounted-for water losses average 16% with losses over 26% being seen [5],[6]. These unaccounted-for losses generally appear to be due to older, slower water meters under-registering, as well as real losses due to service-side distribution system leaks and leaks in transmission and distribution mains [6]. Strategic placement of non-billing AMI meters at system boundaries and other key distribution system locations can help identify actual losses, while newer water meters can help eliminate these apparent losses (green cells in Figure 8). Other losses identified in the AWWA Water Balance can often be identified and mitigated via a water system audit.

System Input Volume	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption Revenue	Revenue Water
			Billed Unmetered Consumption Revenue	
		Unbilled Authorized Consumption	Unbilled Metered Consumption	Non-Revenue Water
			Unbilled Unmetered Consumption	
	Water Losses	Apparent Losses	Unauthorized Consumption	
			Customer Metering Inaccuracies	
		Real Losses	Leakage on Transmission and Distribution Mains	
			Leakage and Overflows at Storage Tanks	
			Leakage on Service Connections, up to Customer	

Figure 8. AWWA Water Balance

Strategy Development

A key aspect of strategy development is the prioritization of AMI system functionality. An example of an AMI implementation priority pyramid is shown in Figure 9. This should be developed by the utility early in the project to encourage discussion and establishment of the priorities for a given utility. This pyramid is not all-encompassing; other systems and concepts important to each utility should be added as part of discussions. This pyramid can then be used to help guide RFP development and evaluation. This process helps a utility understand what they need the AMI system to accomplish and provides a clear picture of how to prioritize implementation in the field and system integration. Note the pyramid illustrates the sequence of the implementation, starting with the foundational items on the bottom row.

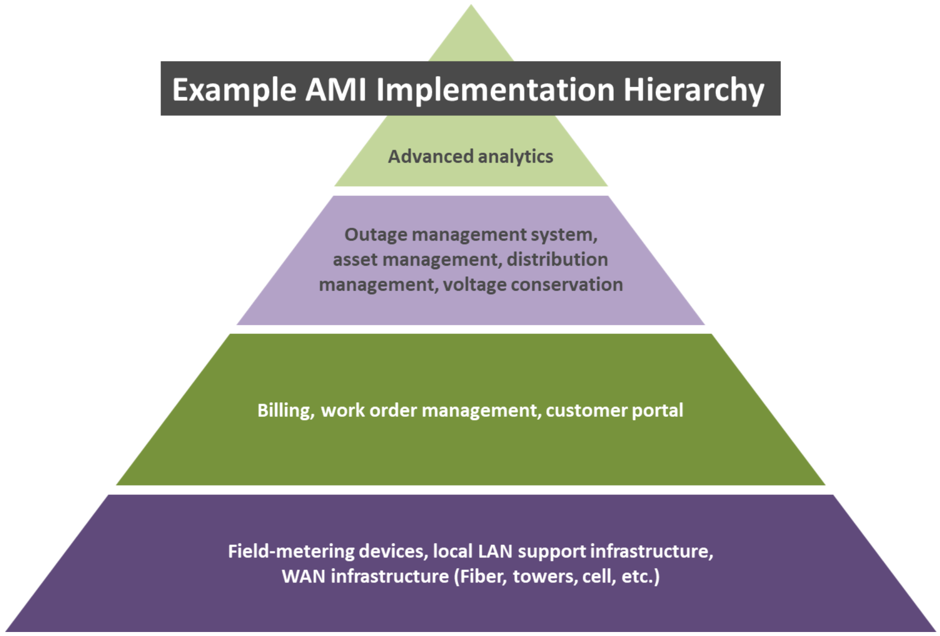


Figure 9. AMI Priority Pyramid

Phase 2: Vendor Selection

Request for Proposal (RFP) Development

Based on the utility's priorities, it is important to create an RFP customized to the utility's needs. This RFP development takes into consideration all of the previous project steps to ensure that the strategy and priorities identified by the utility are captured.

The RFP needs to reflect very specific metering location information so that the bidders can perform an initial radio frequency (RF) propagation study to identify communication infrastructure assets such as data concentrators relative to meter locations. The RFP needs to be specific on the number of meters, types of meters, special considerations such as register-only replacement for parts of the water meter population, potential use of k-base adapters, and many other utility-specific field conditions. Meter location data can come from the utility if they have the latitude and longitude information for their meters (if not, Quanta Technology has had success in the past using service addresses and a geocoding tool to generate these data).

The RFP needs to state all utility-specific meter preferences such as remote disconnect of electric and/or water, customer portal availability/compatibility, outage and restoration support, and many others.

Bid Evaluation

Often, new technologies mean new vendors, so it is not surprising that many utilities don't have in-depth knowledge of the vendors in the AMI space. As a part of improving their knowledge base, we have found that developing an initial vendor list based on a broad understanding of requirements is an excellent starting point. Next, we recommend setting up video calls with each of the potential vendors and requesting a short demo of their AMI system. Topics that should be explored on these video calls are:

- Firm experience and reference accounts
- Staff expertise/experience with deployments

- Clarity of integration in the proposed solution (CIS, SCADA, GIS, and meter data management [MDM])
- History of success with proposed equipment (specifically, with proposed meters and communication systems)
- Indicative pricing
- Ability to meet the required schedule
- Software integration capabilities
- Testing approach
- Managed-service experience

It is important that all members of the planned AMI implementation team attend these video calls.

Phase 3: Implementation

Project Initiation

Field implementation of an AMI system covers a wide range of technologies from field deployment, system integration, and system performance validation. Some key points for a successful field implementation include:

- Strong field-deployment project management
- Strong installation contractor
- Continual community/customer engagement
- Well defined roles and responsibilities among all parties
- Realistic and appropriate test or demonstration plans
- Detailed training program
- What happens after the installer/vendor leaves? (i.e., turnover/knowledge transfer to utility resources)
- Ongoing system support

The sequence of project execution needs to be clearly defined such that initial testing and billing integration are completed before any significant field deployment occurs to ensure the read-to-bill cycle is not interrupted. If the utility plans to use a bidder subcontractor as the meter installer, the process for meter installs needs to be defined along with facility access for office and material storage.

IT System Integration

AMI system integration with other IT systems is critical and must be addressed at the beginning of any AMI project. Most critical is the customer information system (CIS) and its ability to support parts of the utility's vision for the AMI system. If the system cannot support some of the capabilities envisioned (e.g., the utilization of interval data), a new CIS system should probably be a part of the strategy.

An AMI system implementation without a thorough review of existing systems, consideration of the use of new features, and detailed plans for integration can often result in nothing more than a somewhat improved advanced meter reading (AMR) system that simply provides monthly reads, ultimately shortchanging the utility on its investment.

Some of the systems that should be reviewed as part of this process include:

- Billing
- Work Order Management
- GIS
- SCADA
- Outage Management System
- System Planning

Phase 4: Analytics

Analytics

AMI systems provide data across the entire distribution network that, either by itself or when combined with SCADA data or enterprise data, can generate rich insights through data analytics. This covers a broad range of engineering applications including bellwether meter selection/validation for volt-var optimization (VVO), voltage compliance analysis, non-technical loss identification, meter-to-transformer mapping, phase identification, DER and load disaggregation, and development of pseudo measurements to support distribution state estimation. Likewise, the same data can also serve to provide analytics on customer programs and customer behavior such as utilization or adoption of new technologies as part of electrification efforts, including electric vehicles and heat pumps.

The AMI data analytics process includes the definition of the business need and problem formulation, data exploration, preparation of the data, data modeling, presentation of results, and deployment of a "pipeline" for integration with the utility's process. Each application has different end goals and affects different parts of the utility business. Hence, end-users should be engaged throughout the entire process to understand how the data is used and help in defining the metrics and visualizations that are relevant to their process. For instance, bellwether meter selection will be important for engineering teams managing and maintaining VVO infrastructure and systems, whereas voltage compliance issues may be used by compliance teams and asset management and may need to integrate with field crew systems. Data analytics has the power to enhance each of these processes and improve overall performance.

While AMI does enable analytics, it is important to consider what applications the utility would like to develop. Typically, AMI systems are deployed with minimum data gathering capability that may not fully realize the capabilities of the AMI system. If possible, it is best to consider these aspects before the system rollout as opposed to modifying the system after deployment.

> "The City of Clewiston had been interested in updating its utility metering with an AMI system for some time to modernize our utility operations. Through Florida Municipal Power Association (FMPA), we were introduced to Quanta Technology who has been a very valuable resource to help the City navigate the complexities and cost associated with a procurement of this nature. Quanta's expertise and their professionalism has been extremely valuable in assisting Clewiston in the process. I am glad they will continue to be working closely with our team on the deployment of the much-anticipated AMI system in our community."
>
> **Randy Martin | City Manager**
> City of Clewiston, FL

Conclusions

Smart meters and AMI systems are a key component of a grid modernization roadmap that sets the basis for transforming and preparing utilities for the future. A successful AMI implementation involves assessing how the AMI system will benefit the utility and its customers, establishing a priority of the benefits, developing an RFP to meet those priorities, selection of the appropriate system and architecture (vendor selection), integration into the utility processes, and a rollout plan. By using a defined process that integrates a utility's vision and industry best practices, an AMI system can enhance and strengthen a utility's vision for supporting the community and meeting the needs of the 21st century.

As presented in the body of this paper, key considerations for a successful project include:

- A committed cross-departmental team
- A clear understanding of the objectives of the AMI deployment (use cases)
- Prioritization of AMI smart-grid features/functions to meet utility goals
- Consideration of future functionality
- Proper IT integration with legacy systems
- Best use of in-house versus outsourced (hosted AMI) resources
- Prepared staff (compare current processes to new processes required with an AMI system)
- Community engagement throughout the entire process
- Customized request for proposal (RFP) specification that covers a utility's priorities
- A suitable contract for AMI system deployment and acceptance
- Deployment plan and test plan

About the Authors

David G. Hart, PhD, *Vice President, Protection, Control & Automation*, has more than 25 years of experience in the power industry including protection and control, power system automation, smart metering, and various research experience. He has been involved with the development of Automated Metering Infrastructure (AMI) products and systems for over 10 years, directing the product management, engineering, and quality teams. As head of Protection, Control & Automation, he is responsible for overall business strategy, client and program proposals, and project execution for the business area. David holds 30 patents and is a Senior Member of IEEE/PES.

Bob Dumas, PhD, PE, *Lead AMI, Protection, Control & Automation (PCA)*, has over 40 years of experience with increasing levels of organizational responsibility in electrical, nuclear, mechanical, and environmental engineering positions associated with electric utility generation, transmission operations, and advanced metering infrastructure (AMI) smart-grid solutions for some of the largest utilities in the U.S. and internationally. This experience includes 17+ years with Virginia Power Nuclear Design Engineering and 17 years in the AMI industry with Lester Solutions (formerly ABB) and Itron Inc. With Quanta Technology, he has been responsible for project execution of the multi-million-dollar Wide-Area Protection project for National Grid Saudi Arabia, as well as ongoing AMI consulting projects.

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Jeff Richardson, P.Eng., *Senior Advisor, Protection, Control & Automation*, has 17 years of AMI experience in the U.S. and Canada and 29 years in electricity metering. He held a variety of positions in product management, technical support, sales, product development, and manufacturing support with ABB and Elster where he played a key role in the roll-out of Ontario's Smart Metering Initiative, and most recently with Tantalus Systems, where he managed their AMI and Smart Community solutions for public and cooperative utilities. He has also served on a number of regulatory and standards committees with Measurement Canada and ANSI. Mr. Richardson holds a degree in Engineering Science from the University of Toronto and is a registered professional engineer in the province of Ontario.

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