

Energy Intelligence

# MeterMind™ White Paper

Advanced Metering Infrastructure



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## Introduction

With an advanced metering infrastructure (AMI) solution, utilities get unique opportunities for improving their business processes and customer service.

There are a number of business drivers that motivate utilities to adopt smart metering solutions:

- Electricity demands are increasing, yet supply growth is stagnant
- Environmental concerns spur initiatives to lower the carbon footprint at both residential and industrial levels
- Utilities are eager to improve the quality and management of their distribution network

Utilities face a number of challenges when they search for the right AMI provider:

- The new metering solution must interface with all existing utility IT systems (SCADA, CIS, Call Center, etc.)
- All existing meter data collection technologies must easily plug into the solution
- The communications infrastructure must be highly reliable
- The high volume of data generated from a metering solution must be controlled and handled carefully

This white paper demonstrates how the Amplex AMI solution AmpMetering™ integrates seamlessly into existing IT solutions and meters of multiple manufacturers.

With the ability to provide advanced meter data functionalities, delivered as standard configuration or added in the future with minimum disruption, MeterMind™ is more than just an AMI solution. It prepares the utility for a full-blown Smart Grid solution with monitoring and control capabilities in the low-voltage electricity network, enabling a fully automated smart grid that takes meters, streetlights and all other LV loads into account.

## Advanced Metering Infrastructure for energy efficient utilities

MeterMind™ bridges the gap between existing and new data collection technologies, making the technological transformation as smooth as possible. Using multiple communication technologies and vast variations of installation topographies, MeterMind™ is a solution that suits all network configurations regardless of meter types.

MeterMind™ is an advanced, secure and reliable solution for reading utility meters, typically measuring the consumption of energy, water, gas and heat. Using open-source technology, the solution is scalable and can be tailored to meet the requirements of both small and large-scale roll-outs.

Multiple communications carriers - local and wide-area - enables Amplex to deliver a future-proof solution that requires no new wiring and provides software updates automatically via the communication framework. In less than a few seconds, all utility meters in the area are read automatically, and subsequently transferred to the utility's existing billing system without human intervention.

MeterMind™ can be installed with basic functionalities and additional features can be added over time like building blocks to enhance the system when the need arises or when finances are available. With this module-based architecture, MeterMind™ customers can start off with basic AMR system functionalities and later upgrade to get advanced features found only in AMI/Smart Metering, without incurring massive extra costs and IT system changes.

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## Cost Savings and benefits

Upgrading to an MeterMind™ system for demand reduction can generate the following benefits:

- Reducing overall energy use
- Reducing expensive peak generation
- Improving operational efficiency in transmission and distribution networks
- Reducing CO<sub>2</sub> emissions

## Overall benefits of MeterMind™

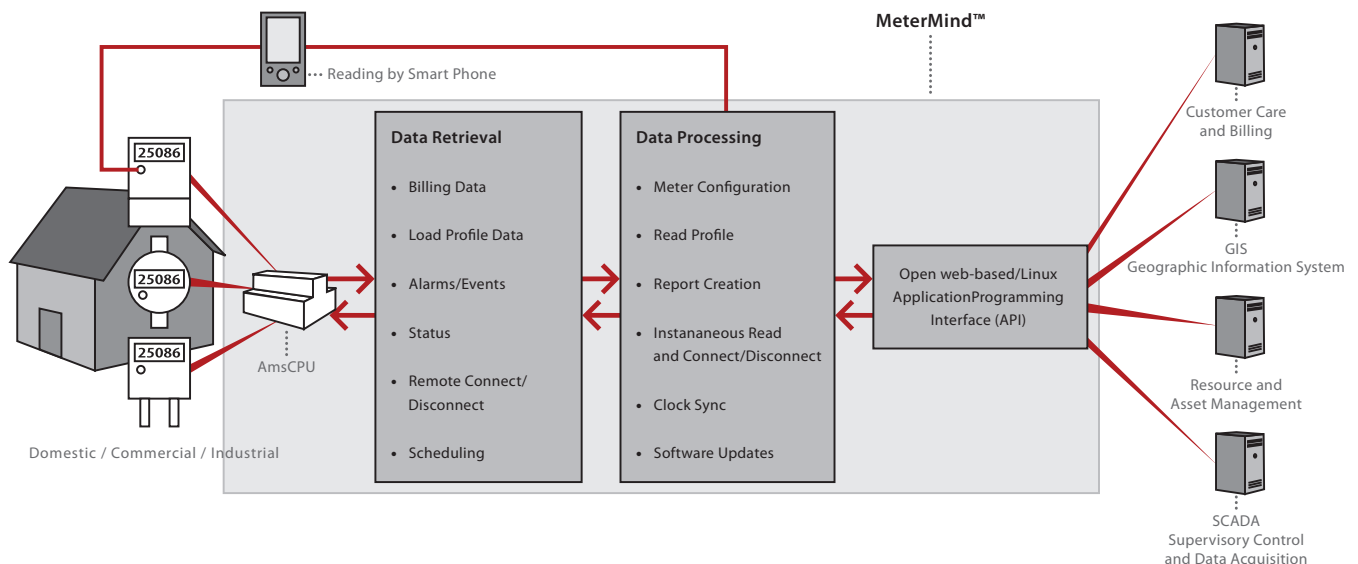
In addition to improving customer service, the features and functionalities of MeterMind™ are all based on reducing costs for the utility:

- Reliable and accurate meter data
- Reduction in billing estimates
- Reduced 'meter-read to bill' cycle
- Improved customer satisfaction
- Reduced and efficient deployment of field staff
- Reduction in network losses due to instant detection of theft and leakage
- Data analysis for improving tariff structures, reducing peak demand and ensuring efficient network planning and reinforcement

## Communications

MeterMind™ communicates via any IP and GSM-based WAN carrier such as GSM, SMS, Ethernet, WLAN and WiFi. Similar to other Amplex solutions, MeterMind™ has the unique ability to switch between and manage different IP and GSM-based WAN carriers.

### Advanced AMI Overview



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## Security and reliability

System reliability is safeguarded through a unique middleware gateway, ensuring that the main processor and communication unit (AmsCPU) is always available.

All modules are tested to the latest international standards to ensure the ultimate performance for environment conditions, e.g. electromagnetic interference, temperature and humidity, etc. AmsCPU units have dynamic IP addresses, but through a sophisticated address allocation scheme, a fixed reference is assigned to each unit. Interacting with other software features, this ensures that the AmsCPU units are always ready to send and receive data.

## Simplicity

The Amplex MeterMind™ solution is characterized by advanced technology coupled with reliable communication and a plug-and-play approach.

- Easy to install, plug-and-play modules automatically discover connected devices
- Open system and few flexible building blocks makes system integration less complex
- Data migration for device configuration and historical data
- Integrates with other metering solutions
- Integrates with other Amplex solutions:
  - GreenWise™ - Energy Content Management
  - StartGrid™ - Low-voltage Smart Grid solution
  - GridLight™ - Intelligent Streetlight Management System

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## Hardware modules

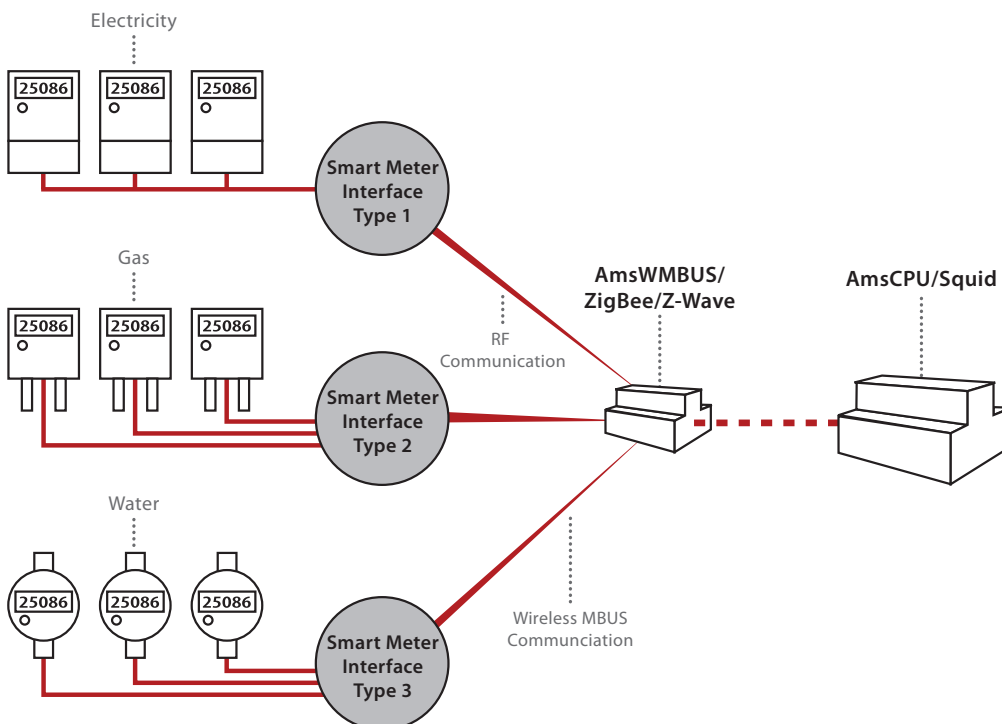
The meter and collection system communicates via a range of hardware modules:

- Meter interface – interprets the meter protocol (proprietary and standard interfaces)
- Local communications module – enables local communications
- Wide area communications and concentrator module – enables wide area communications

These modules form the Amplex Module System (AMS) range and provide the platform for intelligent, remote, two-way communications from meter to central system. AMS modules can also be used in other Amplex applications where remote control is a prerequisite:

- LV substation automation
- Energy Management Systems

The AMS series consists of a range of intelligent units such as AmsCPU, AmsBattery, AmsCurrent and AmsWMBUS, their names referring to their main functionality. Tested and installed in the harshest of environments, the AMS modules are suitable for clients in all geographical areas and for both domestic and industrial applications. Besides the AMS series Amplex also supports the Squid gateway the offers many wireless carriers.



With the meter interface and the local communications modules working together, MeterMind™ can communicate with meters of any protocol (proprietary and standard). Local communications modules act as repeaters, providing the clearest path for the data to travel from the meter to the AmsCPU/Squid gateway module.

Maximum flexibility can be incorporated into hardware modules, enabling retrieval of data from any smart meter over a multitude of communications carriers - both local and wide-area.

Depending on the size and frequency of data retrieval, the AmsCPU/Squid gateway can function reliably with over 500 connected meters.

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## Plug-and-play

Meter interface units use an Amplex bus (A-Bus) protocol for local communications, eliminating the problems encountered with multiple manufacturer-specific protocols.

A unique plug-and-play feature for the utility sector, similar to Universal Plug and Play (UPnP), allows devices to connect seamlessly and simplifies the implementation of new hardware. Other functionalities include:

- Auto-discovery
- Auto-addressing
- Device descriptors
- Dedicated event and control management

## Device management

With Amplex' device management feature, firmware is updated remotely, enabling installation of new applications, OS/firmware updates, bug fixes, etc. Device management is an extremely effective way of managing, controlling and updating field devices in a fast and efficient manner. The following functionalities are part of the Amplex device management feature:

- Remote firmware update
- Firmware lifecycle management
- Remote diagnostics
- Remote configuration
- Remote monitoring of device capabilities

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## Topology and communication

MeterMind™ can be adapted to suit many variations of installation topography, using multiple communication technologies. GSM, WiFi or Ethernet wide-area communications are currently the preferred technologies because of easy and fast installation and commissioning.

To ensure reliability, MeterMind™ employs a system of carrier switching. This ensures that essential data is sent to the central system via alternative methods when the preferred carrier is unavailable. Less important data are either sent later or cancelled if it is no longer pertinent.

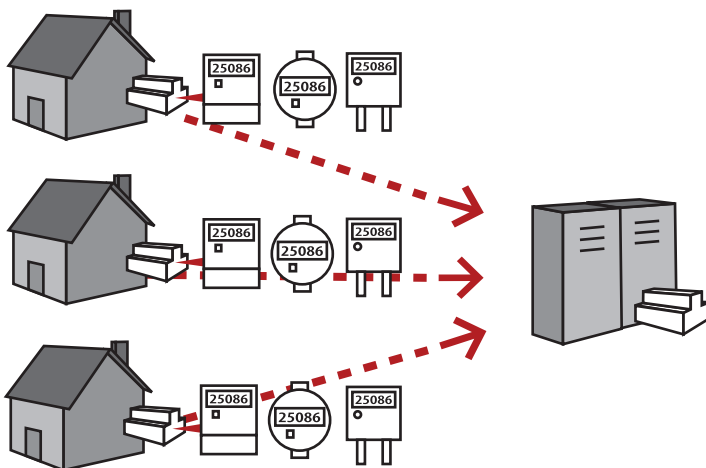
MeterMind™ is most cost effective where many meters are connected to one AmsCPU/Squid. This not only minimizes initial hardware costs, but maximizes the flexibility for future communications upgrades over fewer installations. For instance, upgrading or changing a SIM card in each meter would be a far greater task and incur significant time and cost.

There are three main installation topologies to consider:

1.  
High and low-rise apartment buildings and/or similar clustered metering points such as shopping malls. The optimum local communication media for these purposes is RF communication carriers like ZigBee, Z-wave or Wireless MBUS. Meters of similar protocols are connected to the meter interface module where data is retrieved by a central 'gateway' or AmsCPU/Squid module.

2.

Dispersed housing and/or businesses within a confined locality or region. Grouped in clusters, they use local communications technologies such as Z-wave, Wireless MBUS, ZigBee, Wi-Fi, Ethernet or LoRa. The Amplex gateway modules facilitate a many-to-one mesh type topography similar to that above.



3.

A combination of topology scenarios 1 and 2. Most projects will fall into this category since utility company boundaries generally include consumers located in both urban and rural areas. In this scenario, it is likely that a combination of communication technologies will be best suited. Selective site surveys at locations with different characteristics will highlight the best and eliminate the worst performers.



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## Installation

MeterMind™ hardware modules are easy to install and require minimum time and material for installation. Meters of multiple manufacturers can be connected to common interface modules, and RF communication is used locally. With the appropriate mains connection made, a simple connection between the interface and gateway has the installation almost complete.

For clients who prefer GSM for wide area communications, a single SIM card is required for the entire building. The AmsCPU/Squid module containing the GSM modem is positioned, taking into account mobile network signal strength and connection to the mains for RF communications. The AmsCPU/Squid gateways may also use WiFi or fiber/ethernet cable for communication to the main server. The installation is now complete.

MeterMind™ hardware modules have built-in auto-discovery functionality, making commissioning almost automatic. As a new meter is connected to the system, its presence is noted and reported back to the central system. The meter is assigned a default profile that enables scheduled data retrieval to begin. When the central system has confirmed that the new meter has a valid customer ID, data will be sent to the billing system as required.

Module discovery is signalled by a sequence of flashing LEDs on the module itself indicating that a communications path has been established.

Replacing individual units is a simple process since modules require no site-specific configuration. If a module is replaced, the connected meters are recognized upon reconnection and data retrieval continues as before.

## Amplex Deployment Tool

A deployment tool is used to confirm that the correct meter is connected to the correct gateway module. Further the Amplex Deployment Tool can assist in meter replacements documenting the old and new meter installation and store it centrally in the GreenWise™ system. Any anomalies can then be corrected at this time. The deployment tool ensures fast and easy installation of new modules or meters and enables a final test of the AMI installation prior to commissioning.

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## Billing

For most utilities that consider implementing an AMR/AMI system, the first thing that springs to mind is the prospect of upgrading or replacing the billing system. With an MeterMind™ AMI solution, it's just the opposite. Most legacy billing systems can continue to operate just as before. Data type and format sent from MeterMind™ can be customized to suit individual requirements.

Consumption readings are retrieved from the meter and stored locally in the AmsCPU/Squid and delivered to the central system when required. This storage capability reduces data traffic and provides flexibility during fault conditions. The ability to carry out accurate estimations and then correct the estimations once the fault has cleared is very important.

A complete consumption profile for the customer is also maintained as the readings are stored in the AmsCPU/Squid. Depending on the fault, readings can also be extracted from the meter or the AmsCPU/Squid manually.

Once data is retrieved from the AmsCPU/Squid, it is stored in the central system and validated before the bill-ready data is passed to the billing system. Bill-ready consumption data are sent to the billing system via two methods:

- Automatically, as per scheduled billing cycle
- Upon ad-hoc request, e.g. move in/out process

## Integration

Modern smart meters capture a vast amount of data, not solely related to billing. This data can provide valuable information to other systems or departments.

Using open architecture (XML/SOAP/REST), numerous IT systems can be fully integrated to MeterMind™ to maximize the use of the data retrieved from meters. Typical utility applications that use meter generated data include:

- Billing system - estimation and bill production
- GIS (Geographical Information System) - mapping of physical location of assets
- Resource and Asset management - efficient deployment of staff and materials during of fault conditions
- Customer Care - early and efficient notification of faults as they occur
- Network Planning and Tariff Analysis - efficient network operating conditions
- Revenue Protection - investigate and track down illegal connections, e.g. theft of water, electricity, etc.
- SCADA (Supervisory Control and Data Acquisition) - monitoring dynamic values for an efficient and secure network

Integration configuration can take two main forms: Using MeterMind™ central system as a data repository and hub for other connected systems, or interfacing directly to an ERP system such as SAP, which controls access by other connected systems and acting as a gateway to the MeterMind™ data repository.

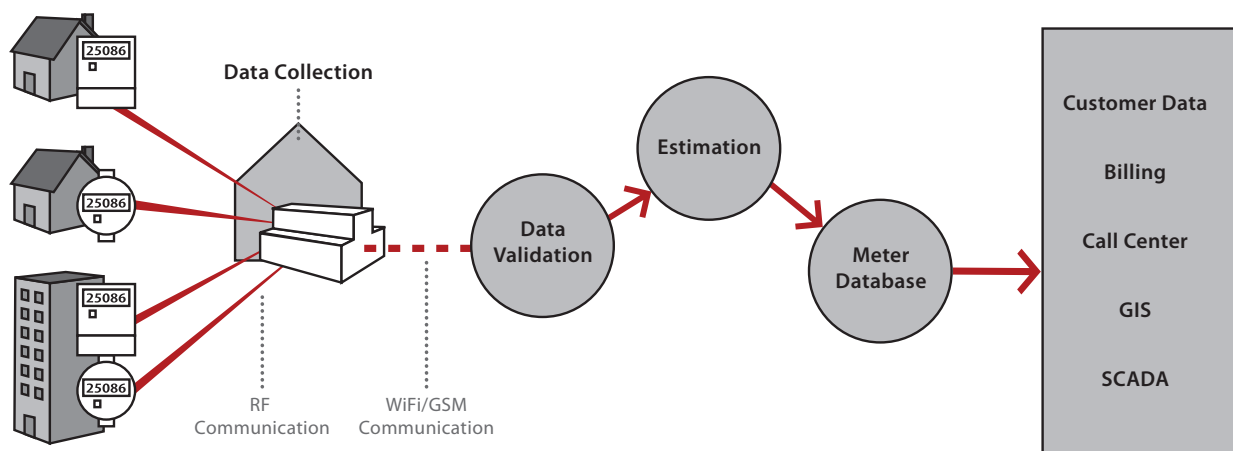
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With the open architecture, integrating to other systems is easy, enabling short duration up-and-run, and fast installation and commissioning times.

Management and analysis of consumption data is vital, particularly for large customers. This analysis often leads to the implementation of new policies relating to demand reduction or restructuring of operations to use cheaper off-peak periods of energy. It enables customers to access their detailed historical consumption data online via the customized web portal.



## Call Centers

Customer service and satisfaction are additional benefits of MeterMind™. With reliable and robust meter readings, bill accuracy increases. Customer query severity and quantity decrease as a result.

Using the customized user interface, MeterMind™ gives direct meter access to call center staff. Customer queries can be dealt with effectively and efficiently, leading to faster clear-up rates and fewer complaints.

Call center staff has controlled access to any connected meter and can initiate:

- Remote supply disconnect and connect commands
- Retrieval of meter reading data
- Remote programming of meters

Customers experience minimal delay while requests are processed and data is retrieved. Requests can be processed instantly or in batch runs where time is not critical.

With MeterMind™, relocations are processed more efficiently. No more site visits, long notice periods and missed appointments. Supply disconnect/connect and end/start meter reading retrieval can be initiated at the required time and date - bill production can then be initiated automatically.

Customer billing and consumption queries can be resolved in a single phone call using reliable and historic meter data. Bill accuracy increases along with fewer estimations and customer queries.

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## Reporting

Another important feature of an AMI system is the ability to generate the data that is necessary to produce reports.

The wealth of information logged and contained inside the memory of a meter is only useful if it can be retrieved and put into context in the form of a report.

Data from MeterMind™ can be used to create comprehensive reports for monitoring the network and reduce leakages and expensive losses, both technical and non-technical. Statistical and operational reports includes the following features:

- Consumption monitoring at nodes on the network
- Loss/leakage identification and detection of non-billed consumption
- Load profiles
- Power factor monitoring

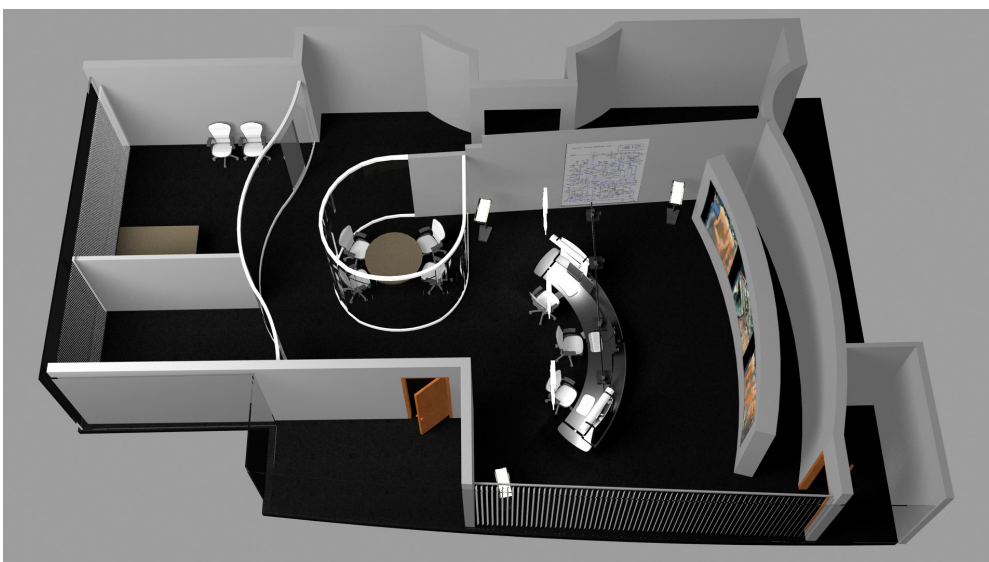
## Control Room Function

Alarm management is another important feature of an AMI solution. Through an Amplex-developed process, alarms and events generated by meters and hardware modules are grouped and/or have their severity prioritized in order to initiate an investigation. Utility resources can be mobilized according to the event, ensuring that most faults are dealt with during normal working hours instead of during costly out-of-hours call-outs.

Network incidents relating to meter-derived data can be monitored on wall-mounted visual displays formed by multiple projectors in a seamless image. GIS software is incorporated to provide the actual network location of incidents as they happen. Incidents could be of a maintenance or emergency type.

Customer groups, e.g. VIPs, can be contacted as soon as a supply interruption is detected or reported. This will enable emergency procedures to be implemented at the earliest opportunity.

The control room function is typically directly linked to the Customer Service/call centre for continuity of information.



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## AMI and demand reduction

For a utility company involved in electricity transmission and/or distribution, influencing or controlling demand is the ultimate feature of integrated network management and load control. This control can be achieved in two ways:

- Price (retail and/or wholesale) being directly related to demand
- Real-time demand reduction

Dynamic rate structures can be implemented, thereby charging a higher rate for consumption at certain times of the day and/or switching off (or reducing the consumption of) certain appliances such as heating, ventilation and air conditioning for a short duration at peak periods. This process gives the customer a degree of choice – switch off or pay more.

Customer consumption can be controlled in several ways:

- Through education and communication
- Locally by the customer
- Remotely by the utility

Once deployed, MeterMind™ can easily be extended as part of a wider review to provide Smart Grid functionalities such as demand reduction.

With MeterMind™, each element of the system is easily upgraded to give improved, combined functionalities:

- AMS modules - additional remote control functionalities
- Communications backbone - can be upgraded if required, with minimal downtime
- Central system - additional interfaces and functionalities can be added

With the core of the system in place, customer equipment and utility IT systems can be added and/or re-configured to significantly enhance the value and features of MeterMind™.

As technology advances and utility requirements change, MeterMind™ can continuously be upgraded to provide a long-term partnership at a low cost.

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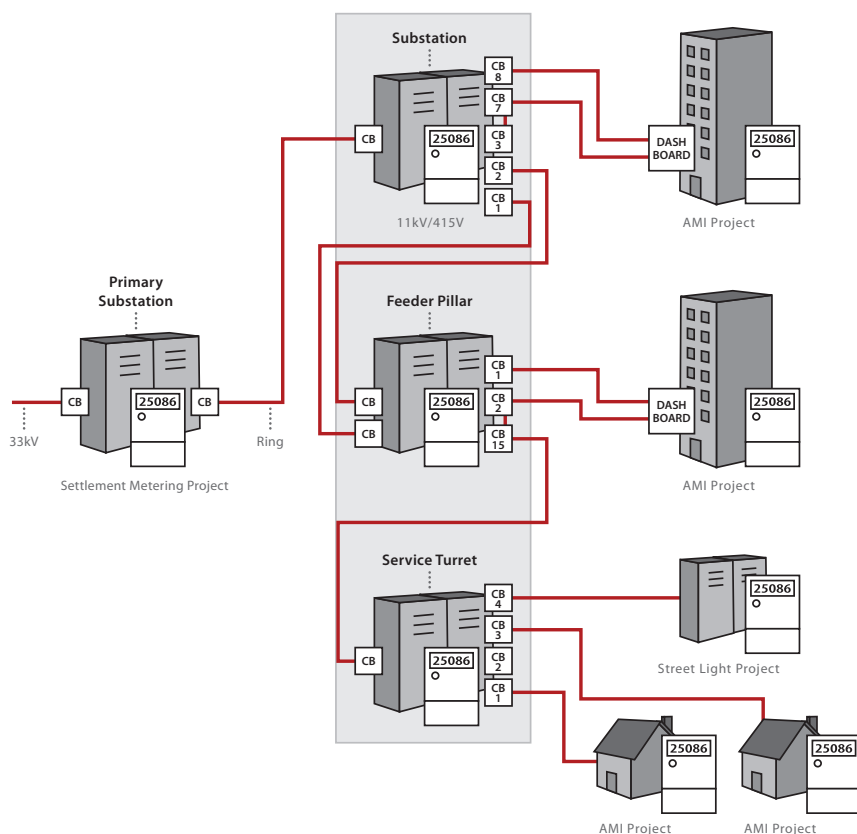
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## Smart Grid in smart steps

Installing MeterMind™ is a significant step towards a smart grid - with a bottom-up focus. Many of the benefits of implementing a smart grid solution rely on gathering data at smart meters installed in the utility distribution system. Collecting and communicating smart meter data and thereby constantly delivering knowledge of the system status, provides an excellent foundation for a fully extended smart grid automation solution at the low voltage (LV) network level.

All Amplex solutions complement future smart grid initiatives, and will seamlessly integrate to create a full smart grid solution in smart steps. With Amplex StartGrid™, smart meters are installed at substation, feeder pillar and service turret levels, in order to remotely monitor and control the entire LV network. Integration of the MeterMind™ solution to distribution management systems (SCADA/DMS), provide the information and control that is needed for full control of the smart grid.



Amplex StartGrid is an ideal solution for real-time monitoring and fault prediction, providing full situational awareness of the entire LV network. In case of a fault, StartGrid provides the tools for initially isolating and fixing the problem as early and fast as possible.

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## About Amplex

Amplex originated as a provider of streetlight control solutions. Over the past years, advanced meter reading has become one of our core competencies, and our proven technology is installed in all environments throughout the world. Amplex is the biggest supplier of AMI in the Middle East.

Aiming for a smart grid, we provide the solutions that will update utilities' current grid to the next level - in smart steps. We deliver customized, energy efficiency solutions for utilities and have significant experience with the energy sector and the challenges it faces. An Amplex solution delivers on-time, reliable results through advanced technology and years of know-how from the business. We know that stability and consistency are key elements of a well-functioning system.