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Gyr

manage energy better

Advanced Metering Management
in a multi-energy environment

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Introduction

The liberalization of energy markets in Europe is well underway, but just as this significant transformation is taking shape, a new one is already emerging: the energy industry and utilities are experiencing the introduction of smart metering and smart grids. These industry changes are, in unison, strongly influencing the development of the market right across the board, from infrastructure and investment questions to pricing and company structures. Continuous, rapid change is a trend that is gaining pace across all industries, but in particular in the energy industry.

The 'breaking-down' of the energy industry into smaller building blocks has led utilities to rethink their business processes and business models and evaluate how they actually produce and deliver energy. Further, utilities also need to think about how their customers consume it. Fluctuations in energy prices and free competition on the market are reducing profit margins and setting pressure for the development of network management and ways to gain market share.

Utilities want to find ways to optimise their processes and find synergies to retain their competitive edge and develop new services to meet the consumer's demand for a one-stop-shop of personal energy products. New technological advancements in smart metering play a key role in this process; they enable the creation of new products and business models and help to create synergies.

Introduction

Market drivers towards Advanced Metering Management (AMM)

Smart metering offers various benefits as utilities are able to make savings financially, operationally, and through increased energy efficiency. The benefits include financial savings from reduced labour as technicians do not have to physically read meters, connect or disconnect them. Invoicing can be based on actual rather than estimated usage, to increase financial efficiency and cash flow accuracy. Better grid management of supply and demand of electricity flow greatly reduces outages and enables accurate network investments. The increase in measuring frequency serves the whole energy market in several ways. The benefits of consumer based peak savings are fairly distributed. It is also easier to divide consumers into smaller segments to manage them more effectively and also develop new energy products.

Legislation regarding AMM is rapidly changing in different European countries. It is largely derived from the energy management targets set by the EU: to reduce the output of greenhouse gases by 20 percent, to improve energy efficiency by 20 percent and to increase the percentage of renewable energy by 20 percent all by the year 2020.

In Scandinavia, governments already have legislation in place requiring hourly data in meter reading and consumption based billing. The European Parliament has approved an agreement reached by the EU institutions on a package of legislation to liberalise EU energy markets. The package includes Electricity and Gas Directives which require the EU Member States to "ensure the implementation of intelligent metering systems." Full deployment is expected by 2022, with 80 percent of consumers equipped with smart metering systems by 2020. The following chart shows the status of smart metering in the EU.

1. Smart metering status in EU.

Source: Capgemini, From Policy to Implementation: The Status of Europe's Smart Metering Market, 2009.

Introduction

Defining multi-energy AMM

In this white paper, multi-energy is understood to include the following energy forms:

- Electricity
- Gas
- Water
- Heat and cold

A multi-energy AMM system is understood as using one Advanced Metering Management system for measuring and collecting energy consumption and other data of two or more of the above-mentioned energy forms even simultaneously from one end consumer. Multi-energy data management in this context also comprises the different data processing functions in the AMM system and the integration of multi-energy metering data into different customer systems.

The below image provides a detailed description of a multi-energy AMM system describing the different system-enabled functions and how they link to different operations of the utility.

Profile reading, instantaneous reading, power quality data and different types of alarm and status data is measured from meters of different energy forms and passed on to the AMM multi-energy system for data processing. The data is then passed on through integration to be further utilised in the utility's different IT systems such as meter park deployment and operation, balance settlement, network operations and delivery control, billing and customer service operations.

Correspondingly, by using the AMM system a utility can manage different types of controlling functions such as contract management tasks to be carried out in the multi-energy device level.
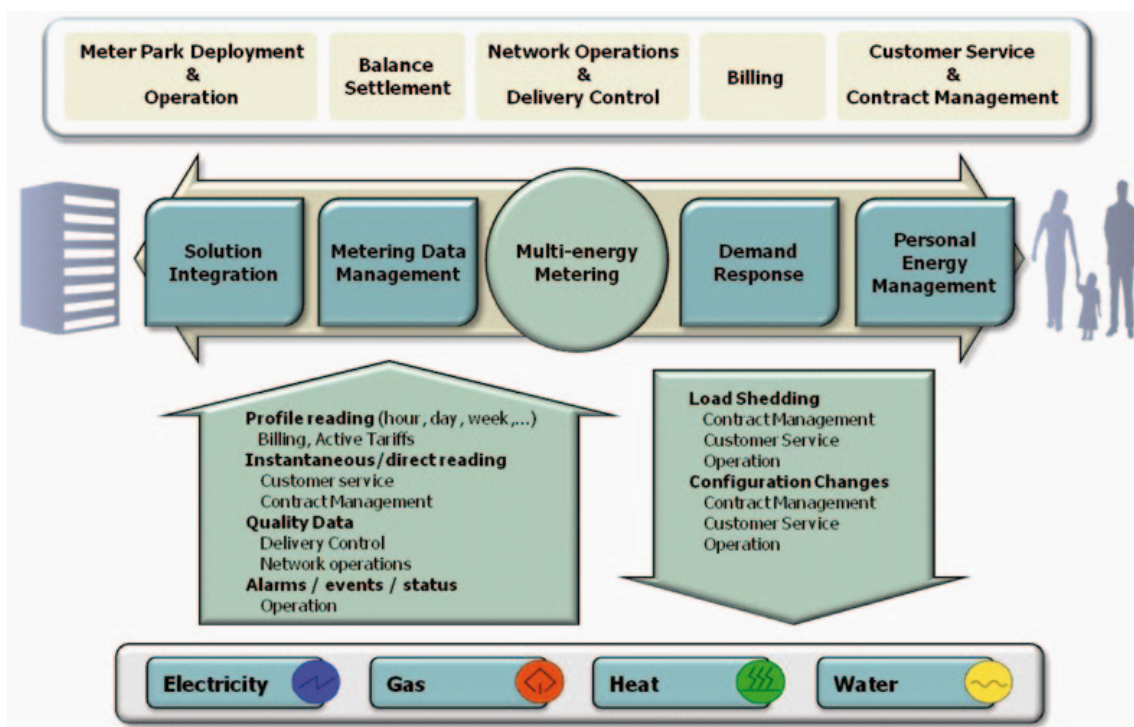
2. Multi-energy solution

Why multi-energy AMM

Lower investment in infrastructure

As there are several energy forms connected to one AMM system, investment in infrastructure can be significantly reduced at the communication and system level.

Different multi-energy structures

There are several architectural solutions on how to construct a multi-energy metering system. The majority of the multi-energy systems are built around the electricity master device. This means that at the hardware level, the electricity meter is functioning as a multi-energy master device, whilst at the same time measuring the electricity consumption and other electricity metering data. When measuring consumption and other metering data from different multi-energy devices, the master device is acting as the data collection and storage device. It gathers and stores metering data from different multi-energy devices, such as water meters, and transmits all the metering data onwards to the AMM system, therefore, there is no need to deploy a separate master device or communication module for each multi-energy device. Additionally, this can reflect positively on operating efficiency in the form of a fixed communication cost (see image 3 a).

Another solution is to use a 'smart box' as the master device. A smart box functions as a communication device and sends the metering data from different multi-energy devices to the AMM system (see image 3 b).

It is also possible to leave out the master device or any other data collection device and transfer the metering data from each meter separately or use a master device to combine the metering data from just two multi-energy devices, for instance (see image 3 c).

The alternatives offer different synergy benefits for system, communication and hardware. When using the energy master device, the savings in hardware and communications can be maximized, where, as in the case of leaving out a master device and using a separate communication modem for each energy form, the synergy benefits are generated in the AMM system and integration level.
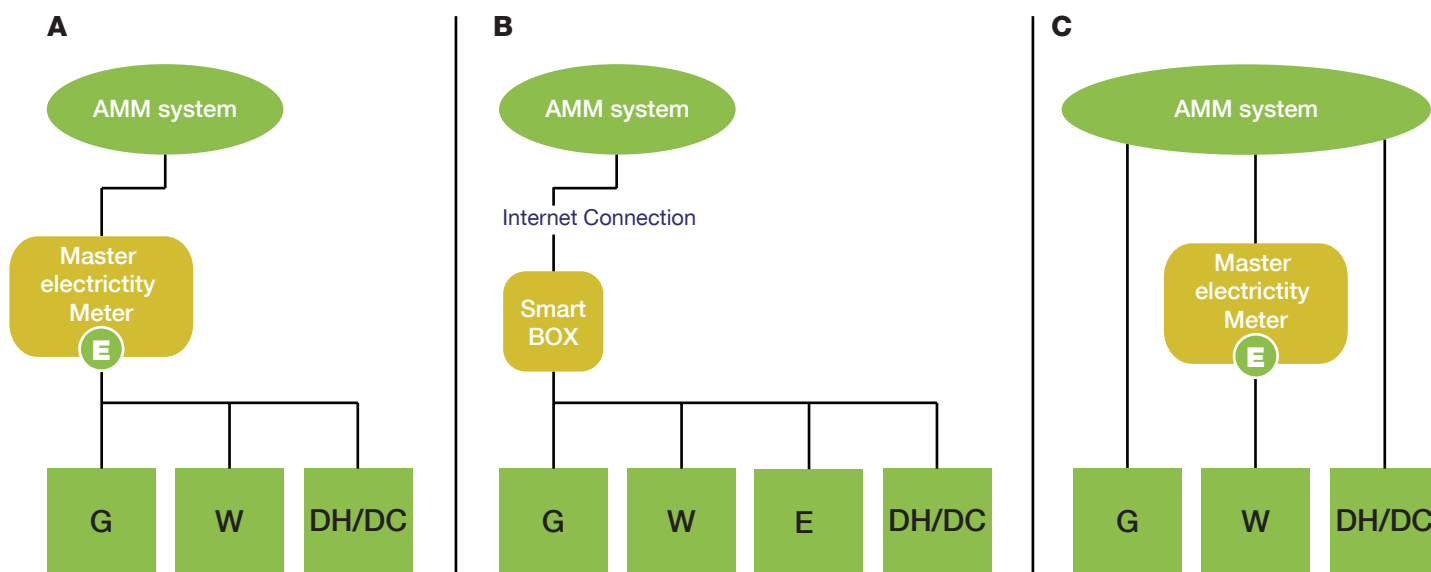
3. Multi-energy AMM infrastructure alternatives

Why multi-energy AMM

Lower operational costs
Savings in infrastructure are further multiplied at the operating level. A multi-energy capable AMM solution presents various opportunities to increase operating efficiency.

Metering data from various multi-energy meters is communicated to the AMM system through one master device, enabling the reduction of communication costs. In the optimum situation the metering data from all of the connected multi-energy devices is transmitted to the AMM system with only one fixed communication cost.

Training, operating and maintaining an AMM system requires resources. These resources will be multiplied if separate systems are used to measure different energy forms. Multi-energy AMM offers synergy benefits as personnel can operate with only one system to process multiple metering data. This will reflect positively on the training and system monitoring requirements, which will, in turn, be reduced. Also the reporting for various purposes such as network management, marketing or sales will be in a unified format for all energy forms. On the whole, the speed and level of customer service will be improved due to synergy benefits, leading to an optimum situation of "one call - all services"

4. Communication costs
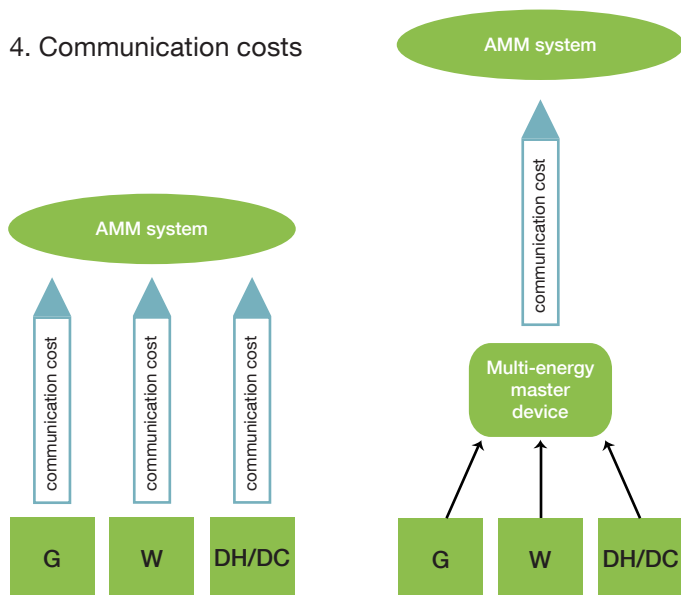
Enabling new services for consumers
Implementation of an AMM system enables the measurement of different kinds of metering data in addition to standard consumption figures. The measurement frequency made possible by AMM means that recent data is constantly available. Metering periods can vary from anything between one minute to one month depending on the end consumer type. It is also possible to measure different types of data at different intervals; for instance profiling data could be measured every fifteen minutes where as data for billing could be measured once a day. Meter reading can also be automatically triggered. For example, the power quality data measurement can be automatically set if based on findings in the validation results. Versatile metering data and real-time consumption figures create new opportunities in the development of new services.

As more frequent metering data is available, differences in the consumption patterns are easy to detect. Deviations from the normal consumption patterns can help to detect different malfunctions in the consumer devices. For instance, it is possible to detect water leaks if there is constant consumption of water throughout the day.

In the case of heat, the multi-energy meters measure not only consumption figures, but also the flow and return temperature of the water. If the difference in the water temperature is not sufficient, it can point to malfunctions in the customer's heat exchanger, failing to extract heat from the water.

Why multi-energy AMM

Widening the product range
Increased measurement frequency presents more opportunities when developing new consumer products using tariffs. Different customer consumption patterns can be used to identify similar user groups and this can be used as a base for developing new products to better meet the consumer's requirements. When combining consumption behavior of different energy forms, the chances for more targeted and versatile product offerings are multiplied. Tariffs can be calculated in the AMM system level, which can significantly reduce the need for manual work and reduce the need for device configuration.

Real time metering data also enables the creation of new services in the field of personal energy management. In order to empower consumers to monitor their personal consumption behavior it is not sufficient to provide consumption data from just one energy form. In order to get a comprehensive overview of consumption, costs and emissions, consumers should be given the opportunity to monitor the use of all different energy forms in real time using a personal energy management device.

New technological innovations also influence consumer energy consumption behavior, and this, in turn, creates the need for different types of energy products and services from utilities. New products, such as heat pumps and fuel-cells, increase the consumer's freedom of choice. They can choose which energy form to use. Utilities with multi-energy functionality can gain a competitive edge in the market by offering consumers versatile services that combine different energy forms into products.

Multi-energy enables new business opportunities
The ability to measure different energy forms combined with the increased amount of new service opportunities in the energy industry is creating new business opportunities for utilities. Legislation regarding smart metering in different countries is today primarily limited

to electricity metering, which drives the utilities towards choosing AMM and, further, to multi-energy AMM. The situation is however changing; for example. in the Netherlands legislation has ruled gas to be included under smart metering.

The ability to measure metering data from several energy forms using the same AMM system presents new opportunities for utilities as they can broaden their customer base and start offering reading and controlling services to other energy utilities. For instance, electricity utility could offer a reading service to a gas company.

Different types of independent service providers are common in the energy industry, offering meter reading, management of energy-related data, invoicing services and information technology and data processing services for power network operators and energy suppliers. Multi-energy metering gives utilities the opportunity to create one-stop-shops such as service subsidiaries or service departments, which can utilise the synergy benefits of a multi-energy AMM system and create and develop new service products for end consumers.

Savings with a multi-energy AMM solution
The table below sets out some of the different areas of savings: single tendering and logistics process, installation process, communication, AMM system and licensing and operating costs. In the table, the savings are further defined and the amount of savings is estimated, where possible. In many areas the amount of savings are affected by the market area labour costs as well as by the utility's current operations model and therefore calculations should be understood as case specific. The below example is based on best practice, where the multi-energy system is offered by one vendor.

Why multi-energy AMM

Area of savings	Saving areas defined	Estimate of savings
Single tendering process	Time and resource savings with one contract evaluation process --> e.g. guaranteed interoperability with single responsible vendor reduces length of tender process	Utility must evaluate the savings based on their internal processes for tender processing and variable costs such as market specific labour costs. If tender evaluation for different energy forms is done separately the cost may be even doubled.
Single logistics process	Synchronisation of information and logistics processes: single vendor for deployment related order and delivery processes --> Decreased margin for errors	Significant savings in logistics Savings can mount up to EUR 20 per metering point depending on the size of the deployment and amount of energy forms related.
Installation process	Single contact and customer relationship management Single visit to the deployment site Single system and PDA tool for onsite installation data collection and verification Single process for introducing all installed devices to the multi-energy AMM system Verifying complete functionality throughout the system	Savings on planning, contacting, travelling and installation will vary based on variable costs such as market area labour costs and the metering point density. A simple example can be presented from contacting costs: contact letter EUR 3 x 500 000 customers = EUR 1,5 million. This amount would have to be spent when contacting is carried out separately. Connecting and populating the AMM system with multi-energy information will generate timely savings of up to ten minutes per metering point depending on the utility's systems' integration level --> Avoiding double processes in connecting and populating metering point related information to the AMM system saves up to: 5 minutes x 500 000 metering points x hourly work cost of EUR 30 = savings of EUR 2,5 million. No costs resulting from interoperability issues.
Communication	Fixed communication costs will be shared between different energy forms Communication hardware such as modems and concentrators	Synergies in communication costs will generate savings of several EUR per metering point per energy form in a year. With large scale deployments, the amount can total up to millions of EURs per year. E.g. 500 000 mp x EUR 2 fixed communication cost x 2 energy forms = savings of EUR 2 million per year. Synergies on the hardware level can amount to EUR 100 per metering point.
AMM system and licensing	AMM system and licensing	Utility must evaluate the license costs of having parallel smart metering systems instead of having just single multi-energy system for all energy forms. Licensing can cost utility several EUR per metering point, which can lead to savings of millions of Euros depending on the size of the system.
Operating costs	operating costs e.g. training, system maintenance and other synergies	The savings in operating costs can be derived from savings which occur when operating a single AMM system instead of several systems for different energy forms. The financial value will largely depend on variable costs such as the labour costs of each market

5. Multi-energy benefits

Technical requirements and best practices

Multi-energy requirements for hardware

The ability to have multi-energy functionality sets certain technical requirements for the metering hardware. To begin with, the meters need to be 'smart' in order to carry out two-way communication with the system. Second, in order for the utility to gain the most benefits from the AMM system, it is a prerequisite that advanced metering technology is used and the meters can measure several different kinds of data in addition to default energy consumption data. Improved measuring technology and technological progress of the metering hardware have enabled this development. The data measured can, for instance, be power quality data such as power outages or variations in power quality, event and status data such as multi-energy device status data or peak consumption figures. In the case of district heat, meters should be able to measure the difference in the outbound and inbound water temperature and flow rate to help the utility rationalise their network management.

To gather these data variations, the electricity master device or another type of smart box, needs to hold a sufficient amount of registers for different types of data and also a sufficient amount of capacity to save and store metering data. The amount of registers and capacity must be sufficient to additionally cover the multi-energy devices, which each require their own register.

Another major requirement is the interoperability of the multi-energy metering hardware. The metering hardware should be interoperable and follow industry standards, which support multi-energy such as M-Bus or DLMS. Industry standards are created in order to give more freedom to utilities when implementing multi-energy smart metering. Working through open standards provides simplicity and opportunity: they ensure a platform for interoperability and freedom of choice, and they also secure investments in large-scale solutions as more than one manufacturer can be used. Furthermore, they allow communication and cooperation between utilities, manufacturers and governments.

Interoperability is crucial when planning and implementing a multi-energy solution as there are several different types of energy meters to be included in the AMM system. This means that the solution provider should have the multi-energy functionality embedded in the meter development processes from the beginning in order to avoid challenges further along the process. Also, it is likely that the utility already has an existing smart meter park in the field, in which case multi-energy implementation would need to be more tailored to cover the existing legacy devices on the field.

Technical requirements and best practices

## Multi-energy for system software

At the system software level, it is crucial that the system has a flexible data model and architecture, as this enables the use of data processing functions for different energy forms. The origin of the metering data should not influence the AMM system functionality at any level; different system processes such as data validation and aggregation and data reporting should operate in a similar manner regardless of the energy form in question.

Data isolation and ownership

At the data collection level, the system must be able to allocate different points of delivery against the different inputs of the multi-energy master device. That is, the system needs to have the ability to isolate the metering data from different multi-energy meters for further data refining processes. Likewise, a utility's metering infrastructure may require that the master device and all the connected multi-energy devices constitute one single metering point.

As discussed earlier, the multi-energy AMM system enables the production of different types of new services which can be offered to consumers or other utilities. In order for this to happen, the system must be able to distinguish the data ownership while processing the data. That is, the united data arriving from the multi-energy master device must be further separated back to independent metering data of different multi-energy devices. For further data refining processes in the utility's other, existing IT systems, the ability to sort and process data separately in the data collection unit and, further, in the data management unit is a multi-energy system prerequisite.

In order for the system to remain unaffected by different energy forms, the data management level of the AMM system should be able to understand different units of measurement, such as cubic meters, kilowatt and megawatt hours, or joules. It should also be able to conduct profile calculations for different energy forms. In case of district heat being used, the system should have the ability to compensate the difference in outside temperature and heat or gas consumption.
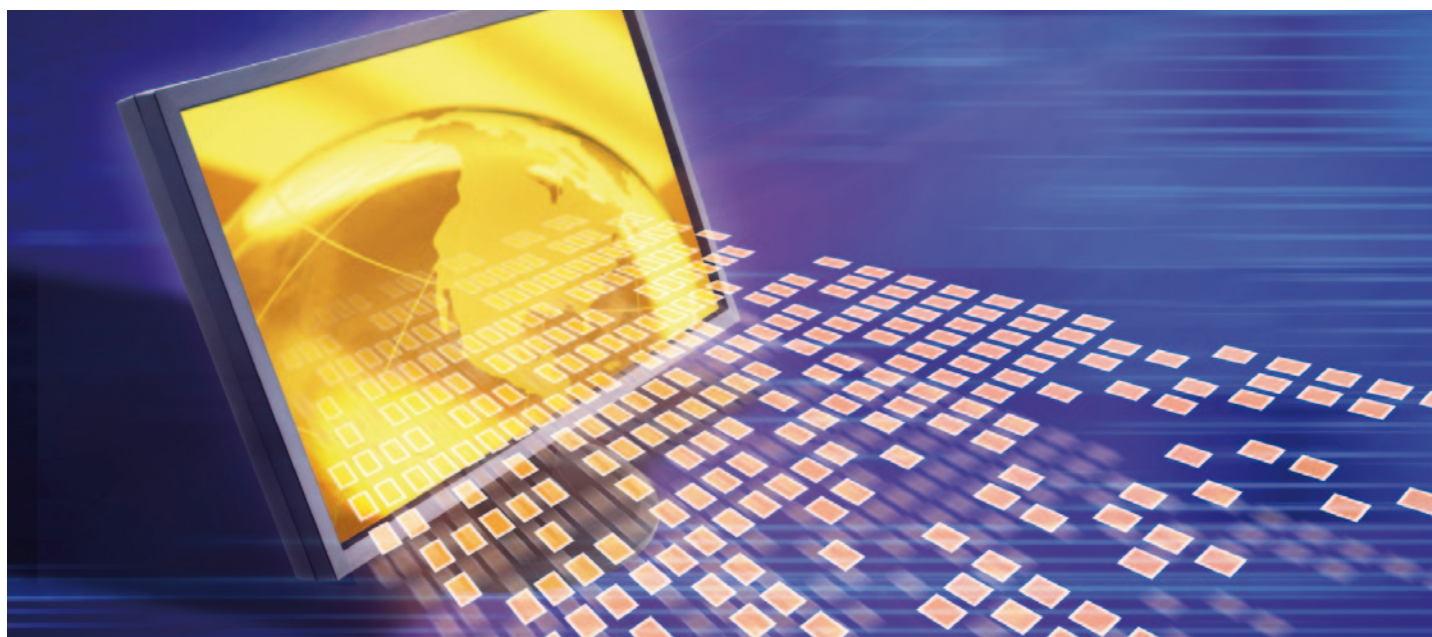
Technical requirements and best practices

System integration and multi-energy

Today there are some standards such as XML and web services in the AMM system level. However, not all the systems to be integrated support these modern interfacing technologies and therefore the solution provider needs to be able to provide interoperability to its customers also beyond the standards: a supplier should have the skills and solid system architecture to support the proprietary and market-de-facto systems when straight forward integration, supported by industry standards, is not an option.

In order for different energy utilities to utilise a common AMM system, the integration platform of the AMM system architecture should be Service Oriented (SOA) and therefore able to support several external systems, such as utilities' different Customer Information Systems. The platform should be easily configurable in order to meet different utility requirements without having to change the whole integration platform. This can be achieved with, for example, the help of platform adapters, which allow the data to be configured in the right format or to contain different types of information based on receiving a utility's systems' needs. The adapter enabling the connection between the systems should ideally be isolated in a separate layer. This means that the integration interface can contain several SOA services – and they remain unchanged despite the technological changes in the background. It also presents the opportunity to introduce new technologies without disturbing the current SOA services architecture. Thanks to the service oriented system structure, integration can be carried out by changing as few AMM system components as possible, thereby making integration simpler.

Security in integration

When using the same AMM system for processing data for different utilities, the role of security and confidentiality at every solution level is further emphasized. Both the system supplier and the utility play an important role in securing the data. The goal is to ensure that only authorised parties may gain access to the information system and prevent unauthorised access.

In order to isolate different utility information and maintain confidentiality requirements, the metering data can be isolated based on contract authorisation, which can, at the energy product level, define the visibility of data. A utility's end customers already have contract based authorisation as they, in practice, have a contract with the utility and have the access to individual metering data for a certain time period i.e. the contract period. In the case of utilities, the contract authorisation is virtual by nature and it defines the people in the utility who have the access to certain metering data within the AMM system.

Technical requirements and best practices

Deployment of multi-energy AMM

The deployment process has several features and requirements, which need to be considered when deploying a multi-energy solution.

In the deployment phase, it is crucial that the process is automated and quick, and that the meters are connected to the system as early as possible in order to enable the utility to exploit system benefits from the very beginning of the deployment process. Thorough planning of deployment is essential and ideally it should start at the manufacturing site of metering hardware to ensure financial benefits are reaped.

Multi-energy requirements for the deployment tool
A deployment tool should be used in the deployment process in order to ensure quick and efficient installation. In order to meet multi-energy requirements, the deployment tool should be capable of receiving work orders from Customer Information Systems of different utilities.

The deployment tool should be able to process work orders of different multi-energy meters simultaneously, so that the same tool can be used when deploying gas, water, heat and cold or electricity meters. The tool should have the ability to isolate different multi-energy installation data from each other in order to secure the relevant utility access to its own deployment and hardware data. It should also have the ability to filter and group work orders based on how the installation work is desired to be organized in practice.

Technical requirements and best practices

Multi-energy check list

The following table lists the features required at different solution levels. It also describes how to achieve the features at a technical level.

Solution level	Features/Functionalities to be included	Technical implementation
Hardware	✓ Device connectivity ✓ Interoperability ✓ Ability to read multi-energy devices	✓ De facto industry practices ✓ Complying with industry standards ✓ Sufficient amount of memory and registers on the master device, multi-energy protocol support
Software	✓ Interoperability ✓ Flexibility ✓ Providing authorised data access for different information user groups ✓ Profile, tariff and validation calculations for different energy forms	✓ Following industry and technical standards, ✓ Modular system structure ✓ Ability to isolate metering data of different energy forms ✓ Ability to process different units of measurement
Integration	✓ Integration to several CISs of different energy from utilities ✓ Easily configurable integration platform ✓ Ability to meet data confidentiality requirements	✓ Service oriented system architecture ✓ Separate integration platform layer with data adapters ✓ Contract based authorisation
Deployment	✓ Automated deployment process with multi-energy ability	✓ Advanced integration between AMR / MDM and the deployment tool ✓ Advanced integration with CIS system(s) ✓ Deployment tool with the ability to: • receive multi-energy work orders • assign work orders against relevant deployment companies • manage work orders for multiple installations on same site • automated installation data management • bar code reading capability

6. Multi-energy check list at different solution levels

Technical requirements and best practices

Introducing multi-energy into existing AMM infrastructure

As discussed earlier, deploying a multi-energy solution sets particular technical requirements to the whole AMM solution, from meters to system integration and deployment. Acquiring the solution and deployment from one supplier ensures efficient deployment and provides the most benefits to the utility.

However, it is not always possible to build the whole multi-energy metering infrastructure from scratch. In order for the utility to expand their operations to cover the measurement of different energy forms, it is possible to make adjustments to the utility's current system or metering park, respectively. In this case, interoperability and connectivity play an important role as combining different solution components of various suppliers can present challenges.

In order to ensure swift deployment and efficient system operation, a thorough analysis and planning should be carried out at each solution level.
Either way, when the decision for multi-energy is made, the solution supplier should have a sound knowledge and adequate experience regarding multi-energy and how to implement multi-energy solutions in order to ensure technically and economically successful deployment.

Landis+Gyr as a multi-energy solution provider

When choosing an AMM system, a utility should evaluate its current and future needs in terms of managing multiple energy forms with a single AMM system. Multi-energy smart metering offers significant benefits for utilities and consumers.

An AMM solution should be multi-energy compatible at every level. Technical requirements need to be met at the hardware and system level, as well as in system integration. Deployment of a multi-energy AMM system is a demanding process that needs to be well planned, automated and professionally executed with support of an deployment tool. Ideally, needs for multi-energy smart metering are considered by a utility before AMM deployment. This enables the expansion of the solution to cover new energy forms later in the solution life cycle, if required. However, the flexible structure and interoperability throughout the system as well as professional planning enable multi-energy to be integrated into the existing AMM infrastructure.

As a world leader in energy management solutions, Landis+Gyr has developed smart metering systems for more than a quarter of a century. It has gained solid experience by selling and delivering hundreds of AMM systems, including multi-energy solutions. Landis+Gyr built its solutions on openness and flexibility. Its multi-energy AMM solution is based on standards that enable interoperability, providing seamless integration and flexibility also for future growth needs.

Landis+Gyr invests both time and money for continuous research and development work in order to further develop its systems. By working together with organisations such as IEC and DLMS User Association, the company stays on the frontier of the latest technological development and contributes to the development of the energy industry as a whole. Landis+Gyr operates in 30 countries across five continents. It ranks as the worldwide leader in electricity metering with a preeminent position in Advanced Metering Management. Its meters and solutions empower utilities and end-customers to

improve their energy efficiency, reduce their energy costs and contribute to a sustainable use of resources. With a proven track record for more than a century, it's Landis+Gyr's primary goal to help utilities to manage energy better.
For more information on how you can manage multiple energy forms better please contact:

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