A GUIDE TO SMART METERING
Stay in touch with the most recent developments in smart metering and smart grids. Visit us at: [http://eu.landisgyr.com/blog]

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Foreword

We are on the cusp of a profound transformation of the energy supply system. In less than ten years we will see a greater change to the way electricity is supplied and consumed than society has experienced in the last century. Smart Metering will help turn a static system with large, centralized generation and one-way power flows, into a multi-directional, dynamic system capable of providing real-time information and integrating micro-generation from renewable energies and enabling demand response. More than that, smart metering is the greatest consumer empowerment tool to be introduced to the energy supply system since its inception.

As the discussion about smart metering has expanded beyond the metering departments of energy companies and technology providers, the need for basic information on smart metering has increased correspondingly. That is the thought behind this booklet; to explain in simple terms what smart metering is, how it works and what benefits it brings. At the same time we do not shy away from the debates on standards and privacy issues.

As the world leader in smart metering and energy management products and services, Landis+Gyr has an obligation to provide factual, objective information on the subject. We have been in the business of energy measurement for well over 100 years, but the introduction of smart metering and the development of smart grids represent a fundamental change – to the benefit of individual consumers and society as a whole – not seen previously. The only way we will be able to meet the energy and environmental challenges of the 21st century is to “manage energy better”.

Oliver Iltisberger
Executive Vice President EMEA
THE ENERGY TRANSITION HAS BEGUN

The world is facing considerable environmental and energy policy challenges, requiring new approaches and solutions. One of the most important projects on the road to a sustainable future is the development of a smart grid. Smart grids will not only provide the essential energy infrastructure required for a dynamic, decentralized energy supply system, but are also an opportunity to increase energy efficiency, optimize energy usage and de-carbonize electricity supply.

The first step in building smart grids is the introduction and uptake of smart metering. This technology forms the basis for energy management; whereas the traditional energy meter was only capable of measuring consumption, a smart meter is an essential operational component in the distribution network.

The implementation of smart metering is a paradigm shift for the energy industry. It is also a significant change for society at large: an intelligent energy infrastructure will bring job growth through the development and implementation of new technologies, enhance European competitiveness as well as support key energy policy goals which will ensure that Europe has a clean, efficient and reliable energy supply system.
INTELLIGENCE WHERE IT’S MOST NEEDED

Optimum day-to-day energy management demands near real-time information. Smart metering provides exact, on-time information on energy usage and power quality at the point of consumption. It extends information availability beyond the substations to the level where energy is consumed. This final section of the network is where micro-generation and demand-side initiatives will take place as smart grids develop – and this is where smart metering enables the most important part of the value chain: the gathering of local intelligence.
Smart energy meters measure energy consumption at given intervals, e.g. every 15 minutes or on an hourly basis. Data is transferred to the smart metering system and onwards to a utility’s business systems via communication networks. Besides consumption data, the meter provides comprehensive information about power quality and enables alarms in case of outages and voltage fluctuations.

The information flow between smart meters and the energy utility is two-way, which provides further benefits: It enables on-demand requests from the system to the meter as well as remote controls of the power supply and selected individual loads. Further, meter settings and firmware can be updated remotely, erasing the need for physical visits to locations out in the field.
Features and functionalities

- A smart meter is a digital, electronic meter for residential, commercial and grid applications
- Smart meters can be used to measure electricity, gas, water and heat
- Meters can measure and record consumption at small intervals, for example every 15 or 30 minutes
- The meter is capable of two-way communication between the point of consumption and the energy utility
- Communication is via Power Line Carrier (PLC), mobile network (2G/3G) or radio waves
- Information on power quality and power outages is also provided
- Smart meters are also able to measure energy generated, such as from solar panels or micro-generation
- Smart meter settings and software can be remotely managed and updated by the utility
- The end-consumer has access to their energy information via an In-Home Display or web portal
1. Smart metering system
2. In Home Display
3. Utility’s IT systems
4. In Home Display
5. Utility customer service
6. End consumer
HOW SMART METERING WORKS

1. Smart meters measure energy consumption/production and provide information on power quality. Electricity, heat, cold, gas and water can all be measured.

2. The data is transferred via Power Line Carrier (PLC), mobile network (GPRS/3G) or radio waves to the smart metering system at the energy utility.

3. The data is collected in the Head-End-System and further processed in the Meter Data Management System.

4. The data is forwarded into further IT systems, e.g. Customer Information System or Distribution Management System.

5. Metering data is used for billing and customer services to provide accurate, rather than estimated, bills and consumer consumption records. Utilities receive regular updates on the status of the electricity network and power quality reports.

   The Utility can send on-demand requests for meter readings as well as control power supply or individual loads in the household.

6. The end-consumer receives bills based on actual energy consumption. They are able to follow their individual consumption patterns through a portal or In Home Display. Real-time data is available to the utility’s customer service personnel, which improves service through streamlined and efficient processes, e.g. when a customer moves house. The smart metering solution can provide an interface to Home Energy Management Systems.
The decision to invest in smart metering means that an energy company is replacing its entire meter park within a short period of time. To reduce business and technology risks, energy companies look for interoperability in their systems. The Smart Meter Coordination Group in the EU that acts on the M/441 mandate defines interoperability as the ‘ability of a system to exchange data with other systems of different types and/or from different manufacturers’.

The Smart Metering Coordination Group combines the forces of European Standardization Organizations (ESOs), CEN, CENELEC and ETSI with the industry and utility stakeholders to coordinate the development of European standards. Today, a comprehensive set of standards for smart metering is available. Standards are a necessary pre-condition for interoperability, but standards alone are not sufficient. To ensure interoperability, companion specifications – in addition to the standards - are needed. The companion specification is a commitment to a specific standard defining the dedicated configuration of the options offered by that standard.
While standards are the responsibility of the official standardization organizations, companion specifications have been traditionally developed by the very largest utilities or by utility associations. Alternatively, associations of manufacturers, such as the Interoperable Device Interface Specification Association (IDIS), provide companion specifications and testing to offer interoperability of their products.

Achieving interoperability requires commitment from all stakeholders and industry players. Landis+Gyr is actively supporting international standardisation initiatives and adheres to the principles of open standards and interoperability.

“Smart metering is all about interoperability; it is built on products and systems working together even if they are of a totally different nature and involve various market segments that range from utilities to users and manufacturers.”

Jean-Paul Vetsuypens, Director Standards at CEN and CENELEC
DATA PROTECTION AND PRIVACY

Interest surrounding the security of communications and data storage is increasing as higher volumes of data are being created and transmitted by smart metering systems.

It is the goal of the security architecture for a smart metering system to ensure the availability of the communications network, while also meeting other critical security objectives such as the confidentiality, integrity and authenticity of users, devices and data. By employing a system that focuses on these objectives a utility can successfully minimize security risks.

The availability of data is fundamental. Utilities need to have constant and uninterrupted access to their meter and billing data. It is vital that they identify and prevent misuse of software and hardware that could lead to a compromised smart metering system and inhibit critical monitoring and control functions.

Integrity can be achieved by implementing cryptographic mechanisms to detect any unexpected changes to data that occur during its transmission and retrieval.

Authentication is necessary as utilities need to restrict the access to data only to those devices and users whose identity has been verified and who are permitted to use the data. This authentication is provided by an identity management system in which the system assigns access permission to identities, and by cryptographic mechanisms during data transmission. This prevents hackers from accessing a smart metering system via devices in the field, or at the head-end application server and data center.
Confidentiality is a universal concern as information privacy is a priority, not only to the end-consumer but also to the utility. A utility needs to ensure that information such as scheduled customer billing data, meter alarm information and home area network events are protected against unauthorized manipulation, both by authenticated users who do not have the required permissions, as well as hackers.

Utilities will benefit by investing in a solution that combines proven security techniques and strong cryptographic capabilities. This will not only protect the availability of their network and metering data, but will also protect their customers from malicious attacks, which affect operations and potentially compromise individual private data.

Landis+Gyr is committed to the highest standards of security in all the smart meters and software systems it installs. The company supports efforts such as the European Network Information Security Agency (ENISA), as well as the relevant authoritative bodies in the individual EU member states, such as the BSI in Germany, in laying down concrete recommendations and standards in the area of data protection and privacy.
THE BENEFITS OF SMART METERING

The benefits of smart metering are spread over the entire value chain. This ranges from end-consumers, who have information on their actual energy usage, time of consumption, and how much they are paying, to energy suppliers, who can offer consumers new and innovative products that contribute to energy savings. With smart metering, society as a whole benefits through the modernization of the energy supply infrastructure, allowing it to meet the challenges of the 21st century.
PUTTING THE CONSUMER AT THE CENTER

Through adding intelligence in the area between the substation and the point of consumption, where operations are “blind” today, the network can be run more effectively and sounder investment decisions by the utility can be made.

Smart metering will enable the development of various tools to help end-consumers to manage their energy usage. The availability of up-to-date consumption data empowers consumers to make informed choices on their consumption patterns and, ultimately, to manage their energy bills – as well as carbon footprints.

With smart metering, and for the first time in history, the end-consumer can assume a greater role in controlling their energy consumption, thereby ultimately promoting energy efficiency. Often referred to as demand side management, DSM, smart metering can offer individuals the power and flexibility to manage and shape their energy accounts at any time they choose.
EFFICIENT SERVICE FOR THE END-CONSUMER

• Accurate bills. Energy consumption can be invoiced reflecting real consumption instead of estimates. No more imposed under/over payments which may require settling and possibly unplanned expenses at a later date.

• More frequent and detailed information allows consumers to better control their energy consumption and change their own consumption patterns.

• New types of energy services will help end-consumers manage their consumption and costs and promote energy efficiency.

• Improved customer service. For example, switching supplier or moving location is faster and easier thanks to on-demand reading and remote control capabilities.

• Improved quality of energy distribution as the DSO’s have better transparency to their network status and trends.
IMPROVED TOOLS FOR THE ENERGY SUPPLIER

- Information on consumption will allow suppliers to make new and innovative offerings based on consumption patterns.

- Better frequency and quality of billing data will reduce complaints from customers, and increase customer satisfaction.

- Efficient, automated processes for billing and contract management, improved load profiling and forecasting.

- Efficiency in debt collection as power supply can be managed remotely; tampering can be alarmed and therefore significantly reduced or eliminated completely.
BUILDING A PATHWAY TO A SUSTAINABLE FUTURE

• Innovation in energy services and pricing can contribute to a reduction in consumption and more efficient use of energy across the system and at peak times.

• Increased knowledge levels among end-consumers regarding their consumption will help them to adjust their electricity usage.

• Less site visits due to automated meter readings and controls, leading to reduced emissions from vehicles.
EFFICIENCY IN NETWORK MONITORING FOR DISTRIBUTION NETWORK OPERATORS

• Automated data collection based on a defined schedule or on-demand requests and remote control capabilities significantly reduce the need for site visits.

• Immediate, exact information on power outages and problems in low voltage networks from the smart metering system to the control center of the grid operator.

• Faster identification of a fault location as the power supply status to individual households can be checked.

• High potential for process optimization and savings in operational costs as smart metering systems can be integrated into existing IT infrastructure.
• Network security can be enhanced through functionalities for remote disconnection/reconnection and for remote reduction/restoration of available power.

• Reduce peak load situations through customer information and the enablement of demand response.

• Improved identification and more detailed calculation of network losses at MV/LV substation level.

• Provision of information for evaluating existing network capacity and forecasting consumption trends, which support network investment planning.

• Measurement of feed-in from micro generation.
Though the industry is just beginning to realize the full potential of 'big data', smart metering solutions that are already in place are bringing significant advantages to end-consumers and energy utilities every day.
ACCURATE ENERGY BILLS

Smart metering enables utilities to provide consumption-based invoicing. This means the consumer only pays for energy consumed during the billing period, and estimated invoices and invoice settlements become things of the past. Today, consumption data is automatically transferred from the meter and smart metering system to the utility’s billing system, making manual meter readings history.

The automated meter reading processes mean a utility can cut down on time-consuming manual work. The system delivers consumption data according to a schedule or on-demand, and accurate meter readings can be obtained from all metering points.
In order to ensure accuracy and data quality, metering values are validated before they enter a utility’s billing system. In the event of missing values from a particular metering point, the smart metering system automatically re-reads the meter.

Smart metering creates added value for the distribution company’s balance settlement processes: Distribution network operators can calculate precise consumption, and sales information can be calculated per energy supplier.
PROMPT CUSTOMER SERVICE AND CONTRACT MANAGEMENT

Smart metering speeds up customer service processes in utilities. Advanced smart metering system applications allow customer service personnel to view accurate electricity consumption data. Other information such as power quality and interruptions at specific metering points can also be accessed.

The benefits of having exact consumption data available in customer service matters are many, especially when discussing invoices or customer claims or complaints. A broad range of tariffs is available with smart metering. When an individual consumption profile is available, it is much easier to identify the most suitable energy product for the customer in question. Scheduled remote relay controls enable certain energy loads to be switched on/off according to a specific schedule agreed with the customer in question. It is also possible to employ dynamic load controls based on electricity market prices.
It is easy both for the end-consumer and the utility to change from one energy product to another. This is because tariff changes can be made remotely. When customers move to a new address, it is no longer necessary for the utility to send someone to visit the site: meters can be read by the customer service personnel remotely and immediately or they can schedule the reading at a pre-defined point in time. The electricity supply can be switched off as soon as a customer’s contract expires, and switched back on when the next resident’s contract comes into effect.

“For us, the ability to manage meter readings remotely and switching off power immediately after the customer contract ends eliminates visits to between 500 and 1000 customers who move house within any one month.”

Matti Lehto, operating manager, Oulun Energia Siirto ja Jakelu.
EXACT INFORMATION ON NETWORK STATUS

Smart meters produce near real-time data on the status of low-voltage networks and the quality of electricity supply. In addition to consumption data, the meters provide information and alarms regarding power cuts, under- and overvoltage in the network and ground faults. Problems can be traced to a region or even to a specific metering point. This makes it possible to react rapidly to network faults and problems with transmission.

Smart metering increases the dependability of the network and ensures the reliable supply of electricity. Reacting rapidly to problems in the network minimizes power cuts and other quality issues.
MANAGING LOADS WITH SMART SOLUTIONS

Smart metering systems enable electrical loads to be managed remotely using relays. Relays enable electricity usage to be shifted automatically from times of high consumption to those hours when demand is low, typically following a tariff structure. In practice, certain electrical loads can be turned off for a defined period of time, subject to the customer’s agreement. Such loads would typically include household underfloor heating and water boilers, as well as outdoor lighting.

TARGETING INVESTMENTS EFFECTIVELY

The comprehensive information provided by smart metering helps distribution network operators to plan and target investments in their networks. Substation monitoring provides information on the load of individual substations, which can be used to define the capacity and dimensions of the network. The correct dimensioning of the network enables the electrical load to be optimized. This then ensures high quality of the electricity provided to end-consumers. Optimizing the voltage of the network also reduces energy losses.

Precise data on consumption patterns will make future energy consumption demands easier to predict. With the help of long-term consumption data and trends for various geographical areas, advance plans can be put in place for electricity production, load management and specific network needs.
TOWARDS AN ENERGY EFFICIENT FUTURE

Electricity networks are set to become increasingly dynamic with the ability to react swiftly and accurately to changes in supply and demand. Information is needed at the distribution level, in particular where the smart grid meets the smart home - the point of consumption. The smart metering system between the substation and the residential home takes on unprecedented importance with the development of a smart grid.
DEMAND SIDE MANAGEMENT

Customer engagement is essential when designing and implementing activities to influence and shape energy consumption and demand in general. Creating awareness through the provision of information is key to gaining end-customer approval and engagement; this in turn allows the end-consumer to make the right decision - at the right time.

Demand Side Management (DSM) can be described as the implementation of policies and measures aimed at controlling and steering electricity demand. It manages consumption, i.e. demand of energy, in response to supply conditions. The latest demand side programs aim to combine customer engagement, technological innovation, codes and standards for appliances, buildings and machines as well as innovative energy pricing with sophisticated financial incentives.

These initiatives on the demand side have been regarded as a major solution in the fight against climate change. Energy consumption and peak demand are reduced, installed capacity and distribution network extension can be limited and greenhouse gas emissions reduced.
Demand Response in Europe could also mean an increase in consumption, for instance when there is an abundance of renewables. It is possible to either cut the generation of renewables by taking for example photovoltaic, wind off line or reducing the feed-in. Alternatively, consumption can be increased in order to make the maximum use of solar and wind power.

Demand response: “Changes in electricity usage by end consumers from their current consumption patterns in response to changes in the price of electricity or to incentive payments designed to adjust electricity usage in response to wholesale market prices or when system reliability is jeopardized.”

SEDC (Smart Energy Demand Coalition, an European industry group specialized in demand side management)
SMART GRIDS

A dynamic environment, following increased micro-generation and changes in energy consumption patterns, sets new challenges to Low and Medium Voltage (LV/MV) networks. Accurate, on-time and real-time energy information as well as powerful tools to manage and automate the LV/MV network are needed to be able to manage multi-directional power flows, integrate power generation from local power producers and handle new power consumption patterns.

As part of the solution, smart meters include functionality that enables them to act as ‘nodes’ at the ends of the network, providing data at the point of consumption. By extending the measurements into transformer level, utilities can increase their awareness on the transformer status and
improve identification of failures, power quality issues and losses in the network. More comprehensive intelligence in the distribution network can be achieved with smart solutions on LV/MV level, such as Smart Substation Automation. Besides the measuring and monitoring functionality, Smart Substation Automation provides tools for analytics and remote or automated controls that continuously maintain the stability of the network. These advanced solutions for network digitalization enable utilities to improve voltage quality, manage decentralized generation and balance energy demand and supply within the network under the most challenging of the conditions.

“In isolation, smart meter data rarely provides measurable benefits. It is only through the implementation of software solutions which can provide additional context that the true value of advanced metering infrastructure can be realized.”

Zach Pollock, analyst, GTM research
Landis+Gyr is the leading global provider of integrated energy management products tailored to energy company needs and unique in its ability to deliver true end-to-end advanced metering solutions. Today, the Company offers the broadest portfolio of products and services in the electricity metering industry, and is paving the way for the next generation of smart grid. Landis+Gyr is an independent growth platform of the Toshiba Corporation (TKY:6502) and 40% owned by the Innovation Network Corporation of Japan, and operates in 30 countries across five continents. It employs 5,500 people with the sole mission of helping the world manage energy better.
OUR OFFERING
Landis+Gyr provides the industry’s widest range of smart metering and smart grid products and services for utility companies, including smart metering devices and systems, as well as energy management tools for consumers. Our product and service offering covers the entire lifecycle of a smart system, from planning to meter reading services.

Gridstream – our solution portfolio

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Personal Energy Management
IHD’s & software tools for individual energy management

Services
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Smart Grid Applications
Sensors, Controls & Software for Sub Metering; Storage Solutions; Demand Side Management & Distributed Load Control; Substation Automation & Supervision; Street Lighting; Micro Energy Management; Distributed Energy Resource & Renewable Integration Management; enhanced Data Analytics and Processing
A TRUSTED PARTNER FOR MANY

Companies world-wide have chosen Landis+Gyr as their partner to deliver smart metering technology. With an installed base of over 300 million electricity meters, 14 million meters under managed services and delivery of smart metering solutions to over 1,000 customers world-wide, Landis+Gyr is a premier and proven global smart metering solutions provider.

“Smart meters herald a new era for energy customers, bringing a transformation in the way they can manage energy use in their homes and businesses.”

Chris Weston, Managing Director of British Gas

“By 2017, we will be able to extend smart metering to all our customers. We believe it will improve the quality of our customer service and increase customer satisfaction”

Mait Rahi, Head of Metering, Elektrilevi
“Landis+Gyr was able to provide a solution that meets our needs, integrate it into our existing IT environment and carry out a turnkey project for 200,000 smart meters.”

Mika Nousiainen, Project Manager, AMM projects at Helen Electricity Network

“Implementation of the smart grid concept in the area of our operation will essentially improve the level of energy efficiency of the system as a whole and will bring added value to our customers in the future”

Agnieszka Nosal, Board Member of RWE Stoen Operator

“The challenge is guaranteeing security of supply at all times, in spite of fluctuations in flow. Today’s metering systems can make an important contribution to the shift in energy use through actively involving customers.”

Christoph Müller, Member of the Board of Directors at EnBW Regional
GLOSSARY

Demand Response
Commercial arrangement between a utility and its customers in which customers agree to reduce their loads when the electricity system – either the network or generation – is constrained.

Direct Load Control (DLC)
Activities performed by the utility that can interrupt load during peak demand by interrupting power supply on customer premises. Load Control is usually applied to residential end-consumers, but can also control distributed loads such as street lights and charging stations for electric vehicles amongst others.

Distribution system operators
Companies licensed to distribute electricity. In the electricity sector, distribution means the transport of electricity on high-voltage, medium-voltage and low-voltage distribution systems to the end-consumer. DSOs are responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area and, where applicable, its interconnections with other systems.

Interoperability
The ability of making systems work together. To reduce business and technology risks, energy companies look for interoperability in their smart metering systems. The Smart Meter Coordination Group in the EU defines interoperability as the ‘ability of a system to exchange data with other systems of different types and/or from different manufacturers’.

Load management
Utility activities designed to influence the timing and amount of electricity that their customer base is able to use.
Renewables integration
The integration of fluctuating energy levels from renewable sources. The difficulty of predicting the timing and amount of renewable energy the sources will generate forces distribution network operators (DSO) to closely monitor supply and demand. This helps to balance Demand Response and the corresponding infrastructure in real time.

Smart meter
Smart meters enable two-way communication between the meter and the central system at a utility. A Smart meter is a device that records consumption of electricity at intervals of an hour or less, and communicates this information at least once daily to the utility for monitoring and billing purposes.

Smart grid
A Smart grid is an interconnected electricity grid. It uses information and communications technology to gather and act on information throughout the grid network. This can include information about the behavior of suppliers and end-consumers, helping to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity.

Standards
Standards aim to develop interoperability of hard- and software from different manufacturers, in order to avoid stranded investment by utilities and barriers to further development. Today, a comprehensive set of standards for smart metering is available. Standards are a necessary pre-condition for interoperability, but standards alone are not sufficient. Companion specifications – in addition to the standards - are needed in order to make interoperability possible.