

THE SMART METER »»

**A POWERFUL DRIVING FORCE BEHIND THE TRANSFORMATION
OF EUROPE'S ENERGY MARKET**

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THE SMART METER: A POWERFUL DRIVING FORCE BEHIND THE TRANSFORMATION OF EUROPE'S ENERGY MARKET

THE SMART METER MAKES IT POSSIBLE TO TRACK ENERGY CONSUMPTION REMOTELY FROM THE POINT OF DELIVERY AND, IN CERTAIN INSTANCES, TO REMOTELY CONTROL DISTRIBUTION TO CUSTOMERS. THIS INNOVATIVE TECHNOLOGY HAS ALREADY BEEN SUCCESSFULLY IMPLEMENTED FOR ELECTRICITY IN SEVERAL COUNTRIES AND IS SHORTLY SET TO BE MADE WIDELY AVAILABLE IN FRANCE TO ALL PRIVATE CONSUMERS. BESIDES THE TECHNICAL COMPLEXITIES INVOLVED IN BRINGING THIS MODERN EQUIPMENT ON STREAM, SMART METERS SIGNAL A MAJOR ADVANCE ON THE MARKET. THEY MARK, IN FACT, A RADICAL CHANGE IN THE ACTIVITY AND INCOME MODELS OF ENERGY OPERATORS, AND EVEN IN CUSTOMER CONSUMPTION HABITS.

THE SMART METER IS A POWERFUL DRIVING FORCE BEHIND THE TRANSFORMATION AND ORGANIZATION OF THE ENERGY MARKET IN EUROPE TODAY.

WHAT ARE THE FORCES DRIVING CHANGE?

A NEW MARKET SETTING

The technology behind the smart meter has come of age at the very moment that progress in opening up the energy market to competition has been achieved by the leading countries of the European Union. The market setting has changed to make way for this advance: new rules have come into force, old operators have made changes and new players have appeared on the scene.

For France, therefore, 2008 marks the first year in which the right conditions are in place to open up the energy market to competition: every company or private individual is now able to choose freely from a range of electricity or natural gas suppliers.

On this new market, the French Energy Regulation Commission (CRE), an impartial and independent administrative body, oversees the system to ensure that it is working smoothly and that all parties involved comply with the rules, against the background of open market competition for the supply of energy.

By and large, energy production is still somewhat centralized and concentrated in the hands of only a few players. Thus, three providers account for 95% of France's electricity generation: Electricité de France (EDF), La Compagnie Nationale du Rhône (CNR), and Endesa France. Producers have to expand in order to gain in strength and remain competitive, as evidenced by the Gaz de France-Suez merger or, at a European level, the takeover of the Spanish company Endesa by the Italian company ENEL.

As for the supply of energy (its sale to the end customer), the competition stakes are set to rise sharply following the emergence of several new players:

- > Integrated companies, such as well-known operators EDF and Gaz de France, who have their own electricity generating capacity and natural gas procurement contracts, together with other French or

foreign companies who may supplement their supply beyond their own capacity by purchasing energy from other producers;

- > Newcomers acting as dealers who buy energy wholesale to then sell it at retail to their customers. Sometimes, to avoid dependence on a model based exclusively on trading, some of these players decide to generate part of their energy supply as well. Poweo is one such case, for example, which currently invests in electricity generating capacity.

Opening up to competition leads to upheavals in the long-term. New players and a new market environment are now in place.

NEW EXPECTATIONS TO MEET

The smart meter also acts to a large extent as a catalyst for the changes expected by consumers in the energy sector.

Consumer expectations and purchasing patterns are changing throughout the Western world. Increasingly better informed in the age of the internet and with more and more choice available to them, they will switch supplier if they do not see their demands immediately met. Far too often, the energy sector is slow to take on board these developments.

Two basic trends now determine energy consumption patterns:

- > **Price sensitivity.** The sharp rise in the price of a barrel of oil and its repercussions on the cost of energy has been poorly received by the general public. The understandable feeling of a loss of purchasing power prompts consumers to drastically reduce their outgoings, even if it means sacrificing quality. Therefore, when there is barely any perceptible difference between suppliers, consumers will opt for the cheaper alternative. Low cost is

therefore set to continue as a trend in the energy sector.

- > **Environmental awareness.** In the wake of climate upheavals and ecological turmoil, consumers are becoming increasingly respectful towards the environment and the conservation of resources. Accordingly, 55% of French people polled think that they have to significantly change their lifestyle in order to limit the impact of the greenhouse effect on the climate¹. European energy consumers increasingly appear ready to change their behaviour to reduce their consumption footprint on the planet.

European consumers now aspire to a more responsible energy market that will enable them to gain better control of their costs and of the impact of their behaviour on the environment.

A NEW TECHNOLOGICAL SOLUTION

On an energy market that has opened up to competition and is faced with these new consumer expectations, several countries have responded with a modern solution: the deployment of smart meters.

A smart meter delivers the following services:

- > Automatic and remote reading of energy consumption. The information is more reliable and more comprehensive and yet is obtained at less cost because it dispenses with the need for meter reading agents to go from house to house. The information is gathered at regular intervals and sent automatically to a centralized data management information system. This remote reading function is known as Automated Meter Reading (AMR);
- > Remote control of distribution from the meter. This allows each meter to be controlled from a central information system. This function is more comprehensive, allowing several operations associated with energy distribution to be performed

remotely, and is known as Automated Meter Management (AMM).

The schemes were initially launched in North America where customers were experiencing major power blackouts. Since then, Italy has conducted a large-scale scheme aimed primarily at reducing its energy distribution costs. In Europe, other schemes are currently under study or have even been brought on stream. In France, eRDF, the new subsidiary of EDF which operates the electricity distribution networks, is set to replace its entire stock of residential electricity meters in France with smart meters between now and 2015. This will result ultimately in the installation of a total of 35 million smart electricity meters, ranking as the biggest AMM scheme in the world.

All these schemes, conducted on such a vast scale, represent a major industrial challenge in the design and operation of the device. They have to rely on extremely efficient information systems capable of ensuring quality and continuity of service even during the meter replacement phase. They also require considerable investments in the various devices required for the system and its set-up to customers. Cost controls can however be implemented by observing some simple principles:

- > Ensure interoperability of the system's equipment to encourage competition between suppliers and to simplify maintenance;
- > Simplify the meter as much as possible for a cheaper and more durable meter;
- > Optimize and shorten deployment times by taking the installation methods and metering device into account beforehand.

Smart meters that start to make a strong mark on the world's energy landscape will contribute hugely to market transformation.

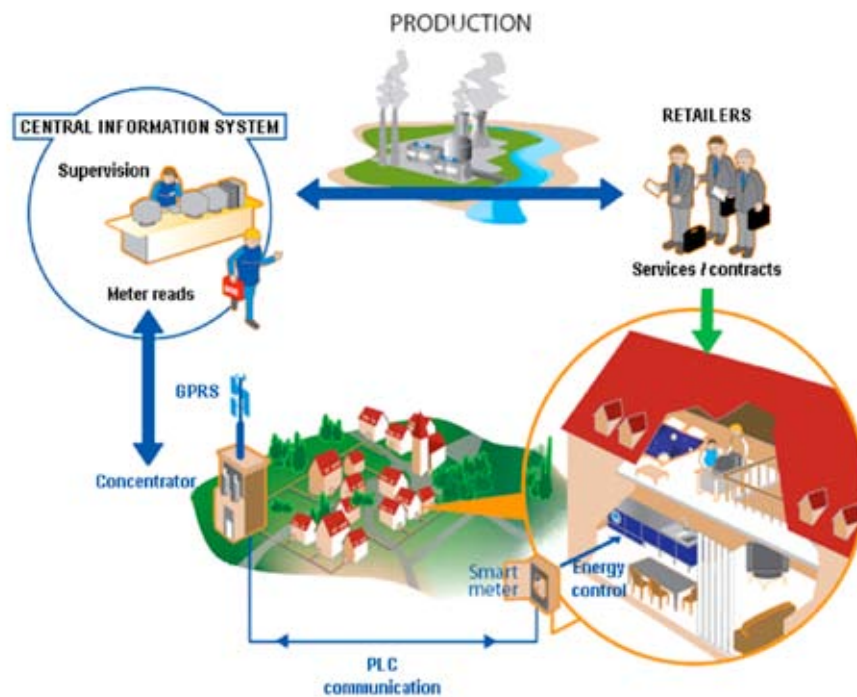
¹source: Direction Générale de l'Énergie et des Matières Premières, 2007.

WHAT IS A SMART METERING SYSTEM?

A SMART METERING SYSTEM OF AMM KIND RELIES ON THE INSTALLATION, IN EACH HOME (OR “DELIVERY POINT”) OF A SMART BOX CAPABLE OF READING AND THEN TRANSMITTING ENERGY CONSUMPTION INFORMATION AS WELL AS RECEIVING ORDERS AND ACTING ACCORDINGLY (E.G. LOAD LIMITING, DISCONNECTION AND RECONNECTION, ABILITY TO SWITCH BETWEEN TIME ZONES, ETC.). THE COLLECTED DATA ARE TRANSMITTED THROUGH A WIDE AREA NETWORK TO A CENTRAL INFORMATION SYSTEM, IN CHARGE OF MANAGING THESE DATA AND THE WHOLE COMMUNICATION INFRASTRUCTURE, AND RESPONSIBLE FOR INTERFACING ALL INVOLVED EXTERNAL ACTORS.

The introduction of smart metering leads to the design and operation of a complex system of communicating equipments and impacts on all market actors.

EXAMPLE OF A SMART METERING SYSTEM



A COMMUNICATING SYSTEM

A smart meter is a device dedicated to reading and managing the energy supply and has, in addition, a two-way communication capability. It can send and receive information by relying on different telecommunication technologies.

In the system described above, the communication infrastructure combines 2 modern technologies to transfer readings and management orders between the central information system and the smart meters.

Firstly, communication is achieved between a set of meters and a nearby “concentrator” by the Power Line Carrier (PLC). A PLC modem linked to each meter and to each concentrator allows data to be encoded and decoded as an electrical signal above the 50 Hz mains voltage frequency.

This PLC technology, which uses the existing network of electrical cables, provides a convenient and economical solution that is particularly well suited to densely populated areas. It does however have a limit since the low range signal deteriorates with distance and is completely lost beyond a certain point (some few hundred metres at most). The PLC is therefore used only to transfer information between several meters and the nearby concentrator, on an existing network structure.

The data are then encoded in digital format by the concentrators and sent to the central information system using the GPRS network. This type of communication is reliable and suited to the transmission of data over large distances with few new infrastructure requirements (e.g. antenna, etc.). Operating costs for the transfer of information by the GPRS network can be optimized by ensuring that off-peak bandwidth time slots are used and by efficient data compression.

In the example (page 6), PLC technology is used to carry information between smart meters and concentrators, and GPRS technology is used to carry information between concentrators and the central information system.

AN INFORMATION SYSTEM FOR DATA MANAGEMENT

The installation of millions of permanently connected smart meters ultimately creates a colossal volume of information to be transferred, stored and processed. The daily transmission of load data read (on a 10 or 15 minutes bases) by millions of meters corresponds to tens of terabytes of data that need to be handled each day.

The management of this data requires the introduction of a powerful and highly complex information system for the Meter Data Management (MDM), able to store and process all these data. The information system must be at one and the same time highly efficient, totally reliable, fully secure but also scalable to adjust to the deployment rate of several million of devices , which can span several years.

With this information system, the smart metering manager is able to operate a transit platform that gathers and stores metering data and makes them automatically accessible to other operators: traders, producers, transport and distribution network managers, etc. Accurate and reliable consumer data are therefore available to all these operators.

The information system for the management of remotely recorded data is the cornerstone of the smart metering system.

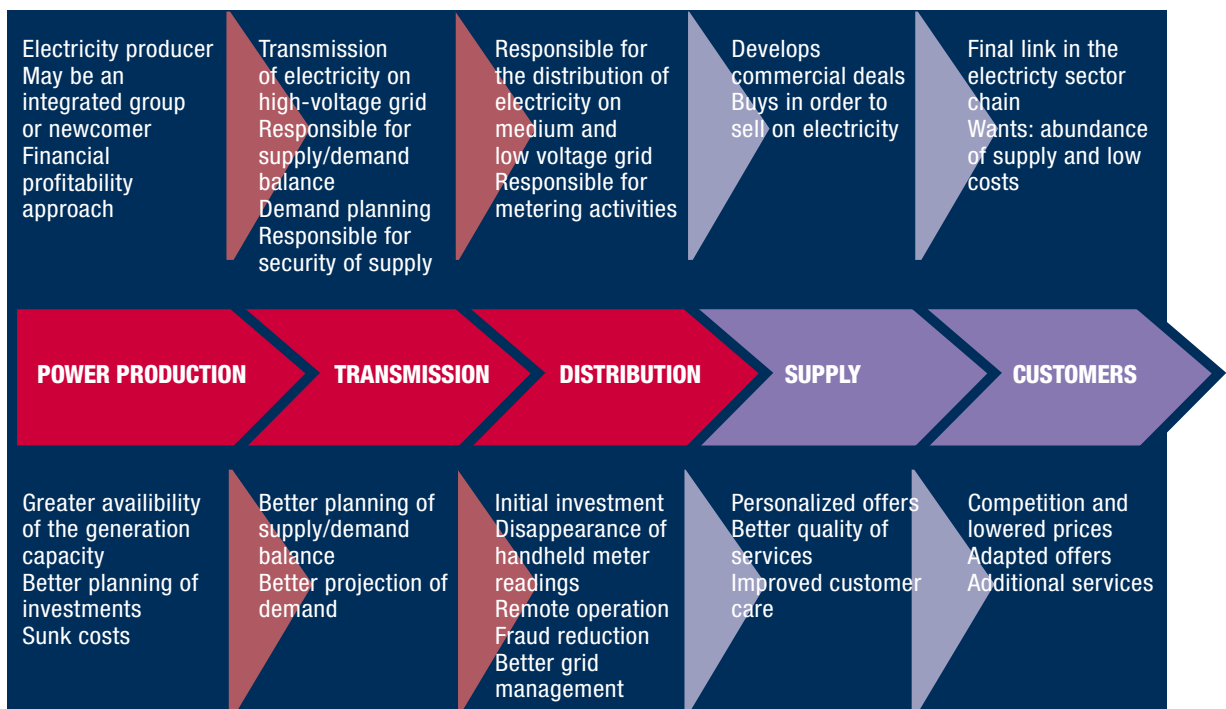
WHAT BUSINESS CHANGES FOR ENERGY MARKET OPERATORS?

THE IMPACT OF SMART METERS AFFECTS ALL THE PARTIES INVOLVED IN THIS PARTICULAR ENERGY SECTOR IN TERMS OF OPERATIONS MANAGEMENT. FOR EVERYONE, INNOVATION WILL BE THE SOURCE OF PRODUCTIVITY GAINS AND INCREASED QUALITY OF SERVICE BENEFITING THE END CUSTOMER.

The advance towards smart metering modernizes the business of every operator, and allows productivity gains and better quality of service for everyone.

In the case of electricity, where smart metering technology has come of age, it is easy to look ahead and survey how smart meters will change the way the various network operators work.

THE ROLES PLAYED BY ELECTRICITY SECTOR OPERATORS AND THE TRANSFORMATIONS BROUGHT ABOUT BY SMART METERING



TOWARDS THE OPERATIONAL EXCELLENCE OF THE DISTRIBUTOR

The energy distributor, usually being the party responsible for metering activities (on behalf of suppliers), is the natural initiator (and key investor) of smart metering schemes. By seizing the opportunity to significantly improve both its productivity and its quality of service to the end customer, operational excellence is truly within the Distributor's reach.

Benefits in terms of productivity can be expected at several levels for the Distributor:

- > Meter read-outs for billing purposes will be replaced by remote meter readings. As readings are automated, the disappearance of door-to-door meter readings saves on time and journeys made by meter reading agents:
 - There is no longer any need to send an agent out at least once a year (more often even under current legal requirements) to read a meter. Tens of millions of journeys and working hours are saved every year;
 - Meter connection and disconnection operations (e.g. moving home, changes in tariff or in authorized maximum power, etc.) can be performed remotely and therefore more quickly and cheaply.
- > Real-time monitoring of all consumption points and of the entire communication chain provides the distributor with full visibility of the distribution network. It is therefore able to intervene more quickly and, in most cases, remotely using software for remote-intervention and remote-distribution mechanisms in order to correct any detected faults and/or outages.
- > This also results in field maintenance and servicing gains. Ultimately, the Distributor may consider using these same transmission systems to tele-operate other electricity network equipment (transformers for example).
- > The detection of consumption irregularities is facilitated by a simple comparison between the outgoing power supplied by a transformer and the power consumed by private individuals linked to the

transformer (less any line losses). This allows losses to be monitored by continuously analyzing the performance of the transformers and improves responsiveness when these losses are detected.

- > Fraud is also more easily detectable and can therefore be reduced. Thus, in Italy, a significant reduction in "non-technical losses" was observed, contributing considerably to the scheme's profitability.

Low value-added (and highly time-consuming for metering agents) read-out activities will be eliminated and new remotely operated metering activities will be made possible. All of which will generate significant productivity gains for the distributor.

Moreover, the distributor is thus able to create a new income stream by selling network operators, in the form of panels, the data gathered and processed by it concerning the consumption times, modes and habits of customers at the various supply points.

In short, improvements can be made to the quality of service provided by the distributor, especially services geared towards private customers:

- > Arranging/postponing appointments, waiting for the metering agents to call and the need to be at home for the meter to be read will become a thing of the past for private customers;
- > Switching supplier or power option will be more streamlined as they will be done without waiting for one of the distributor's agents to call round;
- > By receiving more accurate and more frequent meter reading data from the distributor, the supplier will thus be able to bill on the basis of actual consumption.

As a result, smart metering allows the distributor to provide a less intrusive service to customers while at the same time developing and focusing on contacts that really do provide added value for the end customer.

A distributor embarking on a smart metering scheme is therefore well on the way to operational excellence, achieving gains both in productivity and quality of service.

BALANCING A FACILITATED NETWORK

Balancing is a specific yet fundamental problem throughout the power supply network. As electricity cannot be stored, steps have to be taken to ensure that power generation matches demand at all times.

In France, for example, responsibility for balancing the supply and demand of electricity rests mainly with RTE, the transmission system operator.

Smart meters open up a whole new realm of possibilities for managing the supply-demand balance throughout the network.

The precision of the data supplied by the smart meters will lead to more accurate planning of anticipated load levels and therefore better predictions of the generating capacity needed to meet demand.

Modelling based on a log of more accurate and more exhaustive consumption data will optimize the balance of supply and demand on the electricity grid.

TOWARDS MORE EFFICIENT PRODUCERS

Electricity generation requires substantial long-term investments and enormous short-term flexibility to meet changes in demand. It is these core features of the generation process that are facilitated by smart meters.

The benefits of smart metering will lead producers to use detailed information to optimize their generating capacity in the short term and to decide whether or not to embark on long-term infrastructure investments.

In-depth and exhaustive knowledge of each customer's consumption levels allows producers to optimize their industrial power generation facilities.

Producers will use the accuracy provided by the read-out data (every 10 minutes) to better anticipate peak - and off-peak - consumption, thus optimizing their generating capacity by switching generators on and/or off in line with demand (hydroelectric, nuclear, coal, fuel, gas power, etc.). An advantage is reaped in both economical and ecological terms.

Thanks to the choices made on Day 1, producers will restrict the use of generation units started up in response to peaks in demand, which are often more costly and bigger CO₂ emitters (by resorting to gas, coal and fuel fired thermal power stations).

In this way, smart meters will also contribute to the generation of more eco-friendly electricity.

Similarly, producers will anticipate the long-term needs of customers in each geographical area. They will be able to forecast generating capacity needs more precisely several years in advance, especially generation units reserved for meeting demand at peak consumption times.

One of the direct benefits to the customer is greater security of supply. The decision to invest in production units will be more relevant in each population area thanks to more accurate projections of demand trends. The risk of blackouts will be minimized thanks to better responsiveness in the short term and to more accurate forecasts in the long term.

Smart meters will afford Europe better protection from major blackouts such as those experienced in North America.

TOMORROW, SMART ELECTRICITY NETWORKS

Electricity producers are anticipating major advances with the development of smart networks (AMI: Automated Meter Infrastructure).

The challenge is to move from “monolithic networks” built around a few large generating units, to a “smart network” where production will be broken down into multiple interconnected points thanks to the widespread availability of “smart” and “communicating” equipment. Smart meters will naturally lie at the heart of these electricity networks of the future.

“Micro-production” units are expected to grow exponentially in coming years, especially with regard to renewable energy sources. Micro hydroelectric and wind power generation systems will develop alongside power generation sourced directly from the customer’s home (especially photovoltaic solar panels and geothermal power for heating).

With the installation of smart meters at all supply points, producers will be better equipped to integrate this micro-generation into their overall generating capacity.

As this equipment communicates fully at all levels, the various operators will be able to optimize their production facility and improve quality of service thanks to:

- > More rapid remote detection of faults;
- > Improvement in the service and in the quality of the electricity;
- > Automation of controls;
- > Accurate reading of withdrawals and injections of electricity into the power grid.

Smart meters will prompt each and every player across the electricity network to modernize their operations. They will therefore be the stepping stone to the global and comprehensive modernization of the entire infrastructure of Europe’s electric power network.

REVIVED COMPETITION BETWEEN SUPPLIERS

Smart meters are set to promote competition between old suppliers and newcomers on the market just as the need arises.

One of the important consequences of smart meters will be to strengthen the fluidity, rapidity and efficiency of market processes, once opened up to competition.

Opening up the energy supply market to competition does not necessarily make it dynamic. In fact, a mere 0.3% of private customers had left their old supplier 6 months after the market was opened up to competition in France, many preferring to keep the “administered” tariff set under State control.

This transitional arrangement will end in 2010: private customers will have to choose from the competitive deals offered by the various suppliers. This may cause the market to accelerate sharply, with strong risks of congestion and delays if widespread switches of supplier are made over a short period of time.

Nevertheless, thanks to smart meters, the main operations involved in opening and closing a supply contract with end customers can be performed remotely (for example, read-outs, connecting/disconnecting the service, amending contract power, etc.). The distributor will be able to provide the new supplier with the meter data almost in real time.

These speed and fluidity gains will facilitate changes to electricity supplier and/or to contract options. For consumers, it will be possible to switch quickly, simply and cheaply to a supplier with a more attractive offer.

Thus, by facilitating customer moves between suppliers, smart meters will help to introduce open competition for energy.

MORE SAVINGS FOR CUSTOMERS ...

If, by opening up the market to competition, it was once possible to see reductions of between 3% and 10% in consumers’ annual energy bills, the rise in the cost of oil has dampened hopes for a significant fall in the cost of energy over the short term.

However, thanks to the smart meter, consumers could end up paying less for their energy, but they will definitely be paying exactly for the amount they have consumed.

At present, energy is billed once a year on the basis of the actual reading taken by an agent, and during the course of the year on the basis of an estimate (subsequently adjusted according to the actual reading). As these estimates are likely to give rise to considerable discrepancies, in most European countries consumer movements and consumer associations tend to demand accurate energy billings for each payment requested by the supplier.

This is the principle of billing on the actual reading, known as Time-of-Use (ToU).

With smart meters, suppliers will be able to send out bills based on actual consumption: customers will only pay for what they have consumed in the previous period.

Smart meters will therefore provide suppliers with very frequent and accurate meter data automatically and at less cost. Divisions into all sorts of tariff bands depending on consumption times are therefore conceivable.

Suppliers may offer deals whereby the price paid will depend on the exact moment in which the energy is consumed so that customers seeking savings can adjust their consumption to take advantage of the cheapest time periods.

Driven by the challenge of competition as already observed in other industries (telecommunications in particular), suppliers will undoubtedly go further and innovate into their tariffs: time-tariff formulas, reduced tariff periods, low-cost, pre-payment formulas, etc..

Smart meters will encourage the emergence of cheaper deals for the supply of electricity..

... AND A GREATER CHOICE OF SERVICES!

The technological revolution involved in the introduction of smart meters will trigger a shake-up on a comparable scale in the supply and services available to customers.

With smart meters, end customers will soon be able to see the wealth of offers and services available from competing electricity suppliers.

The primary focus of innovation will be “energy management in the home”. With smart meters, all households will join the modern era of domestic energy consumption. Accurate consumption data will faithfully reflect each customer’s lifestyle and use of equipment. On this basis, customers will find themselves offered a multitude of deals involving sophisticated services for better mapping of trends and control of their energy consumption. The phenomenon of the smart meter will be boosted by the parallel development of the utility box.

These complementary developments will pave the way for better control of energy costs. Suppliers will be increasingly urged to help customers reduce their consumption. They will advise them on better use of their heating and their most energy “guzzling” equipment according to their individual consumption profiles. By knowing precisely how much the customer consumes, they will even be able to decide to reward a fall in consumption with a better tariff. The first deals of this kind have already been launched in France since opening up the market to private individuals, and will only be able to advance with smart metering.

With smart meters, competition between suppliers can be played out in full to create new deals that more closely reflect the expectations of a precise customer segment.

Below are some instances of deals that could well appear on those markets where smart metering for electricity will become widespread:

“A la carte” electricity. With smart meters, the meter will be activated and deactivated by remote control and could even be programmed for a specified period of time. The emergence of prepaid electricity deals is therefore imaginable. At seasonal resorts, for example, customers could arrange an “electricity credit” for a specified amount to meet their needs over a period of time.

“Minimum supply” electricity. As the meters are operated remotely, it will be possible to selectively limit available power. This feature could ensure a minimum supply of electricity to assist “needy customers” or in the event of a payment query to avoid being completely cut off, or even to offer a low-cost deal.

“Demand Response” electricity. As part of a “Demand-Response” deal, suppliers could offer their private customers, for a fee, an arrangement whereby they agree to restrict their consumption during a peak period, in other words authorizing a reduction in their demand. As a result, those responsible for balancing the network will be in a position to match demand to the available supply while at the same time achieving savings for consumers. Such deals are currently emerging in the USA.

The end consumer will benefit fully and directly from the development of smart meters. Their energy suppliers will be able to apply their creative skills to come up with deals that take advantage of this technology in the interests of consumers and in response to their expectations.

THE EMERGENCE OF THE “POWER BOX”

A smart electricity meter, once installed in a home, has two communication technologies

- > The channel to communicate with the central information system, which will usually be based on PLC technology
- > The connection known as “Remote Customer Information” to send data into the home continuously in digital format (e.g., read-out, tariff, authorized maximum power, etc.)

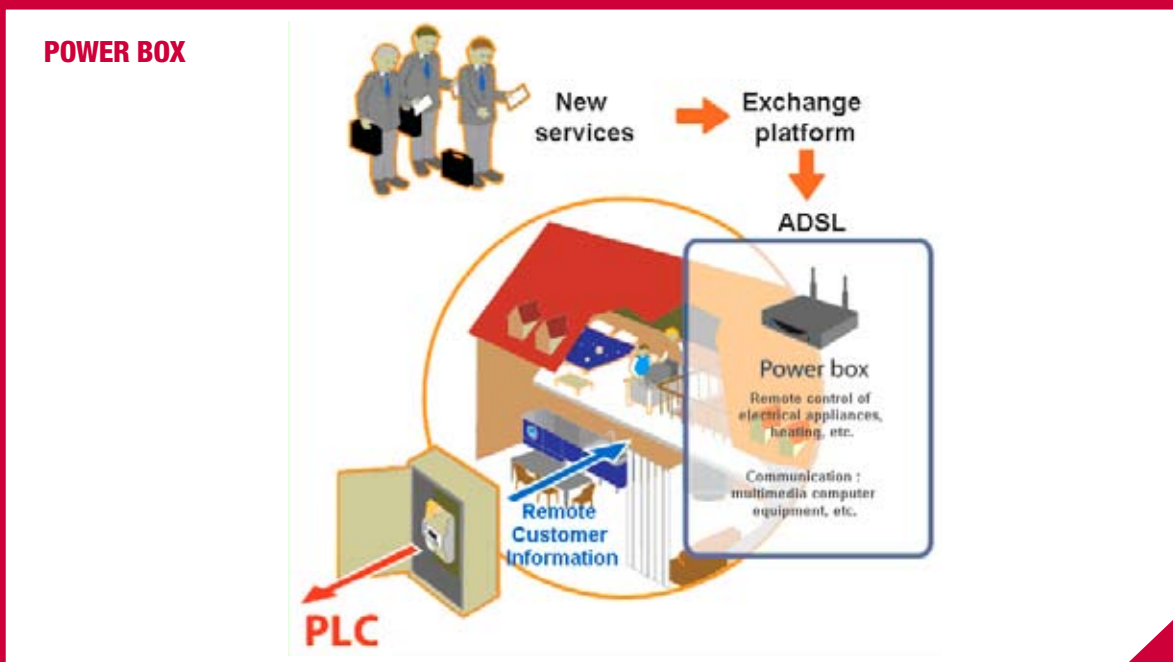
Thanks to the remote customer information outlet, the supplier can extend its electricity supply offer by using this technology and coupling it with a digital gateway or box. These power boxes, like those of internet service providers, are destined to become more widespread in the next few years.

The equipment, which can be fitted with a screen, communicates with the meter via a wireless connection and allows household electricity

consumption to be monitored, with the potential for a whole raft of details (e.g., by room, by appliance, etc.). As it is connected to the internet, it also offers several other energy-related services. Management services of course (e.g. itemized and personalized bills, online customer space, etc.), payment services (e.g. personalized tariffs, etc.), but also several communications services (i.e. sending over-consumption alerts) and even services for remotely programming and/or controlling electrical equipment in the home...

At present, the power box is still in its infancy in France. Two suppliers have come up with a similar offer: Poweo (Poweo Box) and EDF via its subsidiary Edélia (Energie Box). See below.

The power box draws on the possibilities offered by smart meters whilst opening up enormous scope for new services. The imminent developments made possible in France by the large-scale use of the smart meter heralds yet another major transformation, this time not on the energy market but in our homes.





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