ARE YOU READY FOR THE PREPAID METER REVOLUTION?

All you need to know about the benefits of prepaid meters
I. UTILITIES - A REVOLUTIONARY APPROACH

The worldwide business landscape of utilities has changed gradually over the past 20 years. The separation of large state-owned enterprises into smaller private entities has dictated the agenda, leading to intensification of competition and a focus on improving service delivery quality.

1.1 The Mounting Pressure of Challenges

The pressure of multiple challenges is transforming the relatively slow-paced nature of the utility industry into a more dynamic one. The major challenges utilities face—and will continue facing over the next decade—refer to environment, operational efficiency, regulatory compliance, consumer expectations, aging infrastructure, and security (Figure 1). To turn these challenges into business opportunities, stakeholders of the energy/utilities sector need to leverage the power of emerging technologies and new business models to create a revolutionary strategy.

Figure 1: Challenges of Utilities

- **Environment**: Concerns over carbon emissions have an influence on business activities across all industries. But due to the nature of water and energy services, the utilities sector faces greater expectations from governments, international institutions and the public in general. Utilities have the undertaking to not only reduce their own carbon footprint but also help consumers and business customers reduce theirs.

- **Operational Efficiency**: Utilities need to streamline their business processes and, simultaneously, augment the robustness of their services. This is key to optimise revenues and to avoid any loss of energy across the utilities infrastructure. These new requirements will force utilities companies to provide top-of-the-range services with new approaches, such as On Demand and Just in Time.
Regulatory Compliance
Contending with industry regulation is arguably the toughest challenge for utilities companies. To a large extent, regulation determines the limitations for building a compelling business case. Although liberalisation of the utility industry has emerged as a worldwide trend, regulators have a considerable power over the business landscape of utilities. However, as with many other constraints, it can prompt companies to innovate.

Consumer Expectations
Consumers are looking for intuitive ways of interaction with their service providers. The proliferation of mobile devices, the Internet, and (soon) contactless technologies opens a plethora of opportunities for utilities to satisfy the needs of consumers, especially when it comes to billing and informational services. However, consumers are also concerned with factors such as health (with possible impact of radio waves), privacy, interoperability (Can I use my mobile to pay water in the same way as gas and electricity?) and performance (speed to access billing information or consumption data) implications relating to the new ways of interaction with their utility service providers.

Aging Infrastructure
There is a positive correlation between the age of infrastructure and the probability that it will fail, potentially endangering the service reliability. Furthermore, with rising levels of urbanisation and a corresponding shift of water and power services demand, utilities face capacity issues in urban areas and low utilisation in rural ones.

Security
Utilities firms can be targets of attacks because they are considered part of the critical infrastructure of any country and because their billing systems deal with a large amount of data relating to businesses and people. A breach of security could cause a negative impact on the environment, the utility’s profitability and the utility’s image.

1.2 Smart Grid: The Cornerstone of the Revolutionary Approach

Frost & Sullivan believes that smart grids can alleviate the pressure exerted by many of the above-mentioned challenges and create new business opportunities for utilities. While it is true that smart grids alone will not overcome all the obstacles, they will facilitate integration of other strategies related to critical infrastructure protection, renewable resources, distributed generation, and capacity enhancement. This combination of strategies can, in Frost & Sullivan’s opinion, ultimately tackle most of the challenges.

The smart grid concept encompasses a number of initiatives, including smart metering, distribution automation, smart grid communications, home energy management, demand side management, and electric vehicle infrastructure.
The smart grid visions of governments and utility companies are usually divided into functional levels, or stages. The first stage consists of researching, developing and laying down the technology enablers of smart grids. Subsequent stages comprise the deployment of systems and policies that will leverage these technology enablers in an intelligent manner, while the last stage envisions a conscious consumer that is actively involved in making the grid more efficient by directly using low-energy light bulbs and energy-efficient behaviour.

**Figure 2: Smart Grid Functional Stages**

Within the palette of industry initiatives, smart metering is seen by both governments and industry stakeholders as the first step toward smart grids. Research conducted by Oracle among 150 C-level executives in North America revealed that 63 percent of respondents believe that smart metering will top the list of all smart grid components in terms of speed of adoption.\(^1\)

In Frost & Sullivan’s view, smart metering projects should be a top priority for utilities firms because they will provide the necessary data and technological capabilities to spur the other smart grid initiatives.

2. SMART METERING – ENABLING NEW FUNCTIONALITIES

We define smart meters as an advanced meter that identifies the electricity consumption pattern in better detail as compared to a conventional meter. Smart meters have basic functions that conventional meters do not possess.

**Figure 3: Basic Functions of Smart Meters**

Smart meters bring benefits to all stakeholders of the utilities industry. The value proposition of smart meters is different for consumers, governments and the utilities:

- **Consumers will enjoy more accurate billing.** Smart meters will facilitate the replacement of consumption estimates, which are a major source of customer complaints. Furthermore, consumers can use smart meters as a tool that helps them to better manage their energy consumption, and thus reduce costs.

- **Governments could profit from a reduction of resource consumption (water, power) and reduction of CO2 emissions.** In addition, investments in smart metering could represent a moderate stimulus for the economy with the involvement of industry players across deployment projects. This said, the economy could take advantages of these investments.

- **Utilities can obtain savings from remote reading or remote activation/deactivation of services.** Additionally, they will have accurate data that could help to develop more efficient billing and load management systems, as well as reduced outage times.

Maintaining and enhancing this value proposition over time will be difficult, as smart metering projects are carried out in the early stages of smart grids. Smart meters must be future-proof, because many variables—such as the regulatory framework or consumer preferences—are likely to change in the future. In addition, the availability of different payment methods is a key feature when designing future-proof smart meters.

### 2.1 Payment Method Options

Similar to electromechanical meters, smart meters can be either credit meters or prepaid meters. In the case of credit smart meters, consumers receive bills based on regular meter readings—monthly, or even more often. As mentioned above, this will have a positive impact on the accuracy of the bills. Furthermore, if the local regulatory framework allows, utilities could develop different rate structures to address the needs of different consumer segments.

In the case of prepaid meters, as their name suggests, consumers pay prior to actual consumption; currently, these are primarily electromechanical meters. Traditionally, prepaid meters have been targeted at low-income segments. The overall uptake of prepaid smart meters is low, principally because the service is seen as inconvenient. In general, prepaid consumers had to approach payment points to “re-charge” their meters. These payment points are designated kiosks, where consumers can pay with cash to receive a “service top-up.” The payment points are usually managed by the utility company or a third party and tend to be scarce. In addition, credit consumers appear reluctant to adopt prepaid meters, principally because they associate them with supply cutoffs.
However, as the utilities’ smart grids visions become a reality, we expect to see a greater number of prepaid smart meters. There are two reasons to support our hypothesis:

- **Deregulation of the utilities industry has emerged as a global trend.** Competitive utility service markets tend to have a greater number of prepaid consumers. A good example is the U.K., where 12 to 15 percent of consumers are prepaid.

- **Consumers are increasingly budget-conscious.** Prepaid (smart) meters will likely be adopted by different segments than the “high-risk” (bad-debt) consumer groups.

That said, many advancements with regards to regulatory frameworks are needed to allow utilities to build a compelling business case for prepaid (smart) meters while protecting the rights of “high-risk” consumers who in any future scenario represent a significant portion of future prepaid users.

The potential to have both functionalities prepaid and credit in smart meters will likely be welcomed by both consumers and utilities.

- **Consumers will obtain significant benefits.** Traditionally, prepaid consumers have been subject to higher rates than credit consumers. Smart meters that are both, prepaid- and credit-enabled, can increase the transparency of rate structures and diminish any significant deviation in this regard.

- **Utilities, on the other hand, will have more flexibility.** The intelligence of smart meters will enable them to seamlessly change the status of the meter from prepaid to credit upon a consumer’s request. This will enable them to easily comply with regulations on consumer rights.

Payment methods for prepaid smart meters are expected to be more diverse than for regular prepaid meters. Smart prepaid meters are likely to leverage the proliferation of other technologies, such as the Internet and smartphones. New solutions will enable consumers to “re-charge” their meters through a wider range of electronic or online payments (instead of “recharging” through the scarce payment points).

Besides Internet-based payments, either through a desktop computer or a mobile device, contactless payment is seen as a user-friendly payment method for consumers. A number of form factors can be used to enable contactless payments, but smart cards and mobile phones are at the forefront of industry advancements. There are several factors that will likely facilitate the adoption of contactless technologies for prepaid meters:
• **The overall contactless infrastructure is improving across the world.** Financial institutions are deploying more contactless cards, familiarising end users with the technology.

• **At the same time, the acceptance infrastructure at retailers and ATMs will improve significantly.** This will facilitate the process of charging smart cards or mobile phones to subsequently recharge the meters.

• **NFC, the technology enabler for contactless mobile payments, is expected to ramp up in the coming years across several countries.**

### 2.2 Regional Focus

Smart metering deployments and trials are being carried out around the world; Figure 4 highlights a number of projects and initiatives related to smart metering. However, the motivations for the implementation of smart meters vary from country to country.

• In advanced countries, smart metering projects are mostly driven by achieving operational efficiencies and savings, reduction in energy consumption and compliance with national or regional regulations.

• In developing countries operational savings are not that relevant. The business case for smart metering projects is built around reducing non-technical losses (related to theft and tampering of meters).

**Figure 4: Smart Metering Projects**

- **The United States**
  - Stimulus funding for smart grid deployment (£3 B) 60 million smart meters to be installed by 2020

- **The United Kingdom**
  - 27 million smart meters to be installed by 2019

- **China**
  - Stimulus funding for smart grid deployment (£5.3 B). Goal to “smarten” 400 million meters during the next 5 years.

- **Japan**
  - 17 million smart meters to be installed in Tokyo by 2019

- **Spain**
  - Complete smart meter migration by the end of 2018, approximately 24 million

- **France**
  - Completion of smart meter deployment, approximately 35 million

- **Germany**
  - 29 million smart meters to be deployed by 2016

- **Brazil**
  - Pilot projects: Smart City Buzios. 63 million smart meters to be installed by 2021

- **Mexico**
  - Deployment of approximately 20 million smart meters by 2020

- **Italy**
  - Completion of smart meter deployment, approximately 35 million

- **Australia**
  - Strong government support. 2.4 million smart meters in Victoria by 2013

- **India**
  - Smart grids in a study stage. €32.4 million funding or smart grid pilot projects. Government created the “India Smart Grid Task Force”

- **Germany**
  - 29 million smart meters to be deployed by 2017

Source: Frost & Sullivan analysis
3. PREPAID - AN ATTRACTIVE PAYMENT SOLUTION

In every country, energy has become a precious resource; this is a reality for all types of energy and also for utilities firms. The impact of increasing unit costs is important across the globe. However, it is also a reality that low-income consumers have their budget directly and deeply impacted by this price evolution. The standard payment model employed by utilities is to charge customers monthly or quarterly, with bills often estimated based on consumption patterns from the previous year or month.

The next figure gives a perfect example of the price evolution for the three most important energy sources. The French example could be seen as representative of global pricing trends.

**Figure 5: Price Evolution of Energy Prices in France (2011)**

3.1 Cost Optimisation

Using a prepaid service is one option available to consumers that want to better manage their consumption and optimise their budget allocation. These services are well-known within the insurance and the telecommunication markets. They allow consumers to control their budget and obtain full transparency of consumption; consumers will not receive an unpleasant surprise when they receive monthly invoices. But this concept is not only restricted to the financial services or to mobile telecom services, it is also a viable commercial and marketing concept for the utilities market.

For many years, energy suppliers have used prepayment systems to allow all consumers to access services. In the U.K., for example, this solution is widely used, with about 5.8 million prepayment meters installed for electricity. The initial positioning of prepaid meters was to allow lower-income families—or those without a bank account—to access utility services.
But times have changed, and many consumers are now requesting a prepayment meter from their energy suppliers. Prepayment meters have traditionally been more costly than standard payments on conventional invoice or direct debit via a bank account. However, prepaid energy is now becoming increasingly competitive, and energy prices are roughly the same as the standard market.

3.2 Payment Solutions: Coins, Token, Pin, Barcode, Memory Card and Smart Card

There is a plethora of different ways to pay for energy consumption, and this payment solution is directly linked with the meter’s capabilities. Among the different payment solutions used globally are:

• **Coins:** This is the most widely established way to pay via a prepaid meter; coins offer a simple way to use a mechanical process to reload energy credit. The main disadvantage of this system is the vulnerability of the meter itself. Indeed, there is a risk of theft of the cash, while fraud (with specially designed coins) is not rare. The other negative impact is on the energy supplier or subcontractor companies that need to collect the cash on a regular basis.

• **Token or PIN:** This is one of the two most important payment solutions used in the metering ecosystem. This payment concept is based on simplicity and flexibility. There are different form factors to store the token or PIN. For example, the consumer could buy a ticket, including a token number, from dedicated shops and supermarkets. Alternatively, some solutions allow customers to reload a plastic key or a magnetic strip card via a dedicated vendor machine.

• **Memory cards:** This is another solution that is in use everywhere in the globe for water, gas and electricity. When customers enter the card into the meter, the valve opens (for water) and water is made available. The display allows the consumer to check credit left on the memory card. Such cards can be recharged by using dedicated software loaded onto a home computer.
• **Barcodes:** With the deployment of Paypoint payment solutions, barcodes could be used. The customer would pay with a bank card or cash, with the generated barcode allowing the user to reload energy levels.

• **Smart cards:** Chip cards offer the same behaviour as memory card solutions but with improved security. Indeed, a mutual authentication will be performed to secure the payment transaction. The form factor could be a bank debit card, credit card or prepaid phone card. Contact and contactless cards are available on the market.

organisation cannot conduct a fair assessment of its security posture due to its preexisting knowledge of security weaknesses, security infrastructure, and the value of target systems. This preexisting knowledge influences testing methodology or scope and provides inaccurate assessment results.

• **Mobile phone:** With the deployment of mobility, mobile devices could also be used as a prepaid payment solution. Indeed, solutions such as SMS for payment or even online mobile payment will allow the consumer to receive a credit token to recharge the meter.
All these payment solutions are already available for the prepaid market. Based on the required level of flexibility, security and reliability, the table below helps you select your payment solution for prepaid meters.

**Figure 6: Payment Solution Features Comparison Table**

<table>
<thead>
<tr>
<th>Type of Prepaid Payment Solution</th>
<th>Flexibility</th>
<th>Security</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coins</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal Token</td>
<td></td>
<td>●</td>
<td></td>
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<td>USB Token or PIN</td>
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<tr>
<td>Barcodes</td>
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<td>Memory Cards</td>
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<td>Smart Cards</td>
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<td>Mobile Phone</td>
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3.3 Develop a New Marketing Approach

Partly as a consequence of the economic crisis, utilities providers need to develop innovative ways to ensure that they receive payment from all customers, regardless of income levels. A new marketing strategy appeared with the concept of pay-as-you-go; this strategy is based on real-time consumption and on a total control of the usage by both the consumer and the provider. Finally, a win-win concept has emerged. The consumer will pay for exactly what has been used and can adapt budget by monitoring energy consumption. The utility provider is paid in advance for future utility consumption and not based on estimation.

A new market is emerging based on a different way to use utilities. For example, the holiday accommodation market is the ideal niche for prepaid meter usage. The consumption on a weekly basis that is evident at caravan sites, bungalows, apartments and villas means that such locations are perfectly suited to prepaid meter deployment.

Increasing numbers of companies and even individuals can generate their own energy by using solar panels or wind turbines. But what about the energy-generated surplus? In most countries, the utility company provider will buy renewable energy credit. But there are some examples, such as in Kibbutz, Israel, where the local energy producer is able to deliver to individuals the energy surplus produced. At this stage, the prepaid meter is the most relevant solution as it is easy to install and easy to calculate consumption and payment due.
3.4 Regional Focus

The U.S. market is a deregulated market, and most states take their own approach to utilities. In Texas for example, deregulation is in place, and numerous projects such as Salt River Project (the most advanced project of a prepaid program in the United States) are already developed. Such market conditions allow for an easy way to implement prepayment options.

Other countries or regions such as South Africa, South America and India are also using simple prepay meters. The consumer buys a token at stores or a kiosk and enters the token number on the prepay meter to open the utility delivery. Such solutions are deployed by meter vendors such as Itron and Elster. In India, the Pune and Pimpri-Chinchwad province had decided to deploy 6,000 prepay meters in 2011.

In February 2012, the Azerbaijan state gas company decided to roll out a project including more than 400,000 gas payment meters. This is the second step of an already 250,000 installed prepay meters in the Azerbaijan capital city Baku. The final project will be completed in February 2013 and it will cover the entire country. The payment solution used for this project is a smart card that consumers can reload at a variety of stores across the country.

4. WHAT ARE THE BEST PRACTICES FOR PREPAID?

It seems logical that the energy consumption will have to be managed; the emergence of prepaid and smart meter solutions is unstoppable. With this in mind, it is important to understand the key points that need to be addressed to make the meter device selection, deployment, installation and usage a real success.

4.1 Top-of-the-Range Security Product and Features

Fraud for energy, water and gas is a widespread problem, making the need to migrate to secure meters a necessity. In Scotland, for example, the last keycard system used to reload meters was hacked in 2010. Normally, consumers need to go to an accredited shop or point of sale to recharge their keycard. In this instance, the fraudsters proposed best prices during a door-to-door visit. Eventually, customers using the fake keycard were charged twice!

Other examples, such as the use of magnets to stop the mechanical metering counter, have appeared on the Internet. This is why prepaid payment is relevant and security the most important criteria.
There are two different topics regarding security. The first one is to secure the meter itself, and the second one is to secure the payment solution and/or the reload process. In Brazil, for example, many companies have deployed a new generation of meters to reduce the human fraud risk, such as siphoning away power illegally. This is a huge trend as the Brazilian market for meters is about 67 million units.

In Europe, the OPEN Meter Project has defined as a minimum requirement the use of cryptographic algorithms and symmetric mechanisms combined with other technical methods. This implementation will protect data exchange and hardware devices in respect of privacy. Finally, and as a recommendation, a cryptographic processor embedded in smart cards should be considered because of its tamper resistance. Indeed, the capability of a smart card to perform mutual authentication, to generate certificate and to perform validation checking is the guarantee of a top security level.

A simple lack of security could have an impact on the credibility of the energy provider, but also on governments as they are part of the energy ecosystem. This potential loss of credibility will, for a long time, impact the image of the involved company or state.

4.2 Easy to Use, Easy to Install and Integrate

The success of a technology is often directly linked with mass adoption. In terms of volume, the meter market is a promising opportunity as most countries have already planned to migrate to smart meters. In Europe, the smart meter market unit shipment Compound Annual Growth Rate (CAGR) for six years (2011 to 2017) will reach 23 percent.

But what about end-consumer adoption? To meet client expectations, the first essential requirement is the ease of use. Indeed, too many changes (such as payment solution or user interface design) will increase the time before a new device is accepted. For prepaid meters, smart cards are an excellent compromise, as most consumers are using this payment solution in their daily life and feel confident with the security level.

Another crucial target to reach is an attractive price for the meter itself, the associated installation, and the maintenance compared to the associated services and functionalities. Due to the effects of industrialisation, the price of the meter devices will decrease significantly in the next six years; in Europe, the CAGR for 2011 to 2017 will be -4 percent. It is important to have a device able to be easily integrated into the actual infrastructure. International guidelines or standards—such as for the electricity meter ANSI C12.2 for the North American market or the IEC 62053 for the rest of the world—are required to be able to easily use the plug-and-play capabilities of the meter.
4.3 Regional Constraints and Possible Barriers

Prepaid meters provide an opportunity for energy suppliers to be paid prior to energy delivery. But above all, such devices offer a real opportunity for consumers that have financial problems that prevent them from paying traditional bills. However, there are regional constraints behind this simple solution that should be considered.

One of the constraints could be national and international standards guidelines. We have already mentioned ANSI for the North American market and IEC for other countries. From time to time, countries have defined communication protocols with dedicated standards. For metering, the DSMR (Dutch Smart Meter Specification) is one example of this.

For the prepaid metering market, the payment infrastructure could also be a potential problem. Indeed, the prepaid payment could require a bank account, an ATM or dedicated machine and/or shops to reload credit. Without this infrastructure, the prepayment could be difficult. We estimate that by 2015, the number of ATMs per 100,000 adults in Africa will be 28; at the same time, it is expected to be 165 in Spain.

One of the good options to overcome this kind of problem is to use an existing network. In Africa, for example, the GSM network is in place, and the region has already witnessed massive adoption of mobile banking due to the lack of banks and ATMs. Such established infrastructure could also be used for the prepaid metering payment. As a result, SMS prepayment (and later NFC) via a smartphone should be relevant for this region.

4.4 Where is the Value Add?

Real-Time Interaction

Without doubt, the adoption of the prepaid meters for all kinds of energy will be linked with customer experience. The results of a 2008 Latin American customer survey\(^2\) highlighted that consumers value the control of consumption in a real-time interaction as the most attractive advantage of switching to a prepayment system. In Argentina, 45 percent of respondents stated that this was the most compelling reason to switch. This interaction is clearly the attractive point for the consumer; this is the key for mass-market adoption.

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2. (Source: Socioeconomic Features of Residential Users Carmen de Areco District)
On the other hand, it should not be forgotten that the possible risk of disconnection due to a lack of credit is mentioned as the most important disadvantage of prepayment meters. An easy way to reload credits without threat of service disruption will be key to the success of any prepaid offering.

**New Customer Experience**

The ability to use a mobile phone to interact with the prepayment platform is likely to feature in the next phase of development. Mobile phones are massively deployed worldwide, and their usage for services other than pure voice communication offers strong potential. Payment information (number of credits, balance or real-time consumption) appears as relevant added data. And all these services are available with a single device—the mobile handset.

Most of the time, payment is requested on a monthly basis. However, unlike a standard invoice, it is based on active and necessary consumer action. This payment action is able to generate a completely different way to manage the energy consumption. Indeed, from a consumer’s perspective, prepayment will allow a better understanding of how the energy is consumed.

There is no doubt that the prepaid systems constitute a flexible way to pay, with the option of employing different payment solutions and, above all, without extra cost.

**Price Approach**

Finally, to promote the installation of prepaid meters, energy providers or third parties are promoting an interesting pricing approach.

To be sure to reach high levels of consumer satisfaction, the cost of the service/energy should be lower or at least on par with standard prices. The consumer, after the cost impact of the device itself, will benefit from promotional and lower tariffs. The cost of service will also be lower and will provide a greater convenience for consumers; the consumption and remaining balance are easily readable on the meter itself. Online services with dedicated Internet platforms to reload credits are also available with a simple and interactive design.
5. CONCLUSIONS

More and more, industry conversations refer to smart grids and positive energy, but finally time has come to focus on the most interesting technology: energy efficiency. Energy should be seen as a treasure and a rare resource, and should be used and managed in a clever way: minimising and optimising consumption, while securing the metering device and associated payment solution.

This is a wonderful opportunity to promote to the consumer a new approach to energy consumption. Based on real-time experience, and with the option of payment via a mobile handset for better flexibility, this could prove the best solution to manage energy efficiency. Furthermore, Near-Field Communication technology will deliver a more secure way to pay and a better user interface for friendly usage.

With the rise of positive energy building by using off-grid solutions, the energy, as a treasure, will be generated by individuals. This micro-generation of energy will be shared locally outside the standard grid. In this situation, the prepaid meter will be a central point for payment and security.
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