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Smart Metering FOR DUMMIES®

CGI Limited Second Edition

Smarter metering for more sustainable energy use

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We've been instrumental in every major Utilities industry change since 1990. We provide the systems for energy markets in Britain and globally to work effectively. We understand the unique challenges faced by Utilities in Britain. Our knowledge will help the market reap the benefits of investment in the information and communication infrastructure created by deploying smart metering.

CGI have invested in smart solutions which support eight British Utility companies with their domestic smart meter programmes. We are continuing to invest in the British Utilities industry and bring the commitment, financial security and deep experience of complex systems to enable the low-carbon British economy of the future.

Smart Metering FOR DUMMIES®

2ND EDITION

By Chris Beard, CGI

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Introduction

Welcome to *Smart Metering For Dummies*, your guide to the exciting new world of smart metering and the impact that it's likely to have on the utilities market and beyond.

About This Book

The words 'exciting' and 'metering' rarely make it into the same sentence – but all that's about to change. Smart metering is not only set to revolutionise the metering services sector, it's also the catalyst for the single biggest wave of change to hit the utilities industry since the introduction of retail competition. This book explains the *why, how,* and *when* of smart metering and its effects on customers, suppliers, and distributors.

To keep things simple, we use the term 'smart' to refer to smart meters and 'conventional' to refer to existing meters.

Foolish Assumptions

In writing this book, we've made some assumptions about you. We assume that:

- You work in the utilities sector and understand the basics of how the electricity and gas markets work.
- You want to know more about smart metering and how it will affect suppliers, distributors, and customers.

- You understand some of the utilities and metering jargon (we include a glossary at the back of the book, just in case).

How This Book is Organised

Smart Metering For Dummies is divided into six concise and informative sections:

- **Part I: Get Smart.** We discuss the business drivers behind the move from conventional to smart metering and the benefits to be realised by the key stakeholders.
- **Part II: What is a 'Smart' Meter?** We explain what makes a meter smart and how it differs from its conventional cousin.
- **Part III: The Anatomy of an Advanced Metering Infrastructure.** We describe the key components of the infrastructure required to support smart metering and attempt to demystify some of the associated smart jargon.
- **Part IV: Feeling the Impact of Smart Metering.** In this section we take a look at how the key stakeholders will be affected by the smart revolution.
- **Part V: Looking to the Future.** Smart metering won't happen overnight. In this part we examine some of the long-term parallel activities that will influence, or be influenced by, a smart metering rollout.
- **Part VI: Top Ten Smart Tips.** This nifty part is a list of the essential things to remember about smart metering.

Icons Used in This Book

To make navigating to particular information even easier, these icons highlight key text:

The knotted string highlights important information to bear in mind.

The Dummies man indicates real-life anecdotes to illustrate a point.

Where to Go from Here

As with all *For Dummies* books, you can dip in and out of this book as you like, or read it from cover to cover – it won't take you long!

Use the headings to guide you to the information you need. If you require any more information, feel free to visit us at `www.cgi-group.co.uk/utilities`.

Part I

Get Smart

In This Part

- Exploring the move towards smart metering
- Discovering the benefits for the customer, supplier and distributor

We're all responsible for climate change. For example, UK residents contribute over 40% of the country's carbon dioxide (CO_2) emissions and energy usage. In this country alone, leaving domestic appliances on standby when not in use cost over £900 million in 2008! To address this, everyone needs to become more energy savvy. With soaring fuel prices and more and more families falling into fuel poverty, the motivation for a change in behaviour is growing. What's missing is the information required to make smarter decisions.

This part looks at the drivers for introducing smart metering and examines the benefits for some of the key stakeholders.

Driving towards Smart Metering

Smart metering provides:

- Customers with the information they require to become energy savvy and make smarter decisions about their energy usage.
- Suppliers with the means to better understand and service their customers.
- Distributors with an effective tool to better monitor and manage their networks.

In addition, smart metering enables those customers who choose to produce their own electricity from microgeneration in addition to consuming from the grid (so called "prosumers") to be financially rewarded for their contribution . It also helps distributors to better manage this contribution.

What's in it for the customer?

Individuals need to understand their energy consumption in order to make intelligent decisions about it. Currently, customers are informed of their energy use via a bill that arrives months after they've used the gas or electricity. The bill typically only tells the customer the cumulative consumption since the last bill and, more often than not, even this is estimated. It isn't surprising that customers don't feel empowered to manage their energy use.

But providing individuals with the timely, accurate, and detailed information they require to take control of their energy use is only one of the benefits that smart metering can bring. Other benefits include:

- Estimated bills will become a thing of the past. Customers will know what they owe and will be able to budget better.
- New, innovative tariffs will appear, tailored to meet the needs of specific customers' lifestyles.
- Customers will get better service such as on-demand readings (for example, on changing supplier or moving home).
- Smart meters will measure electricity generated from domestic microgeneration, enabling so-called "prosumers" to be financially rewarded for their contribution.

What's in it for the supplier?

For the energy supplier, smart metering will enable the transformation from an energy supply company to an energy services company. Smart metering will allow a supplier to get closer to its customers, to better understand and service their needs, and, at the same time, allow the supplier to reduce its operating costs:

- The cost to service customers will reduce with increased customer self-service. Suppliers will have fewer bill queries, complaints, and site visits. Call centre staff will become more productive.
- Meter reading costs will reduce dramatically as meters are read remotely.
- Suppliers will be able to differentiate themselves through an extended range of products and services offered into the home.

- Timely consumption information will allow suppliers to better manage customer debt.
- Energy theft will be reduced through smart tamper alarms.
- Improved visibility and control of customers' consumption behaviour will enable suppliers to better balance their wholesale positions.

But in addition to 'smartening' up their existing operations, smart metering also presents suppliers with a means to differentiate through pioneering new products and services, thus creating a new battleground for retail competition where the customer-savvy and innovative supplier will triumph.

What's in it for the distributor?

Smart metering offers distributors the opportunity to extend their much heralded 'smart grids' to individual customers on the low voltage networks. Indeed, in many countries, the desire for smarter grids is the key driver for the introduction of smart metering (check out Part VI).

Here are some of the benefits that smart metering will bring to distributors:

- Smart metering will provide distributors with the ability to more accurately bill suppliers for use of the distribution networks in delivering electricity to their customers.
- Functionality within smart meters will enable system faults to be notified and located more quickly following power cuts and interruptions.

- Smart metering will give distributors better visibility of their networks, enabling more cost-effective maintenance regimes.
- More detailed consumption data will enable distributors to measure, rather than model, network losses, reducing the need for reconciliations and providing greater revenue certainty.
- As with suppliers, distributors will benefit from reduced theft through smart tamper alerts.
- Smart metering presents the opportunity of active demand management, controlling load at individual premises to better manage the network.

Who else stands to benefit?

Everyone stands to benefit from smart metering:

- The increased use of remotely managed Time of Use (ToU) and block tariffs (see Part II) will help spread energy consumption more evenly across the day, easing the stress on distribution networks and reducing the need for costly generating plant to meet the peak demand.
- An overall reduction in energy consumption instigated by an energy-savvy public will reduce impending gaps between forecast demand and generation and help restore security of supply.
- Less consumption means less CO_2 emissions and less climate change.

Part II

What is a Smart Meter?

In This Part

- Discovering what makes a meter smart
- Unearthing the smart impostors

What exactly is a smart meter and why is it cleverer than the little box currently stuck on the wall? This part looks at what makes a meter smart and how it differs from its conventional predecessors.

Smarter than Your Average Meter ...

So what makes a meter smart? Traditionally, meters sit under your stairs or in the garage and are only disturbed when the meter reader comes to take a reading. Well, at first sight, smart meters don't look a whole lot different as you can see in Figure 2-1. Like their conventional cousins, they still sit in infrequently visited locations, but now they're not even disturbed by meter readers.

Figure 2-1: These meters look similar but are a world apart.

Surprisingly, there's no absolute definition of what a smart meter is and this lack of a universal standard is an obstacle to many national smart meter rollouts (which we talk about in Part IV).

However, this section delves into the widely-accepted characteristics of a smart meter.

Two-way communication

In addition to being remotely read, smart meters can be remotely instructed and re-configured. Actions which, in the case of conventional meters, necessitate lengthy site visits and meter changes, can now be performed remotely in near-real time.

Actions that can be remotely performed with a smart meter include:

- **On-demand meter readings.** For example, reading a meter in near-real time in response to a customer phoning the call centre.
- **Change of tariff.** Changing tariff rates and tariff structures in response to a supplier-instigated price change or a customer electing to move to a new, innovative smart tariff, for example.
- **Change of payment method.** Switching between credit and pre-payment modes.
- **Change in read frequency.** Changing the consumption read interval from, say, monthly to daily or even sub-hourly.
- **Load limiting/shedding.** Remotely controlling an agreed portion of a customer's consumption in order to help balance generation and demand or as a means for preventing customers from running up massive debts while still having access to energy.
- **Tamper alerts.** Automatically detecting, notifying, and responding to attempts to tamper with the meter.
- **Disablement/enablement.** Turning supply on and off in response to, say, a tamper alert.
- **Messaging.** Communicating directly with the customer via the smart meter and Home Display Unit (HDU – described in Part III).
- **Firmware updates.** Remotely updating the software embedded within the smart meter in order to fix bugs or add new functionality.

Detailed consumption

Smart meters are capable of recording consumption in far more detail than their less sophisticated, conventional cousins. Meter readers typically visit every quarter but not always when you're at home! So the level of consumption information available to customers and suppliers is pitiful. Suppliers have no means of encouraging people to change consumption behaviour and customers have no means of knowing what their consumption behaviour is!

Smart meters can record very detailed *Time of Use* (ToU) consumption down to sub-hourly. ToU refers to a meter's ability to record *when* consumption takes place rather than just *how much* is consumed. Customers can see how their consumption varies during the day and respond to new ToU-based lifestyle tariffs that encourage them to use cheaper energy. Changes in behaviour can have the effect of flattening consumption peaks which, in turn, reduce the need for expensive, carbon-polluting peaking plant and network reinforcement.

Not just electricity

Smart meters exist for commodities such as gas and water as well as electricity. Given that electricity doesn't mix well with either gas or water, gas and water smart meters tend to be battery-powered. Battery technology is constantly improving but, to avoid the costs of site visits to replace batteries, these meters tend to spend a lot of the time asleep, waking up according to a schedule to take and transmit readings.

Time to find out about Time of Use (ToU)

A meter that can record ToU is called a 'restricted' meter and records consumption by having different registers active at different times. For example, a restricted two-rate meter may have one register that records consumption overnight and another that does so during the day. This enables the supplier to apply different tariff rates that reflect the differential between the wholesale cost of day-time and night-time electricity.

Smart electricity meters, on the other hand, have ready access to a power supply and are therefore frequently used as the means of communicating data from gas and water smart meters. The gas and water smart meters 'piggy-back', by communicating via low-power radio to the electricity smart meter, which stores and forwards the data as additional registers within its own meter.

Export as well as import

Whereas conventional domestic meters only record consumption, most smart meters are also capable of recording electricity generated from domestic micro-generation plants and exported to the distribution grid. The ability to measure the output from microgeneration means that "prosumers" can be fairly rewarded for their contributions, which makes smart meters one of the key enablers for the widespread adoption of micro-generation.

Not quite smart enough ...

The following technologies often arise in smart meter conversation but shouldn't be confused with the real thing.

- **Automatic Meter Reading (AMR).** An AMR meter can be read remotely but reading the meter is the *only* remote function supported. The benefits of AMR metering are restricted to reducing meter reading costs to the supplier and the ability to bill the customer based on actual meter readings.
- **Clip-on electricity monitors.** These little devices are sensors that clip onto the cables feeding conventional electricity meters and wirelessly transmit near-real time consumption information to a portable display unit located elsewhere in the house. The display unit shows how much electricity is being consumed and how much CO_2 this represents.

  However, clip-on electricity monitors have significant limitations when compared to smart meters. There's no equivalent clip-on monitor for gas or water meters, no remote supplier access (so none of the supplier or distributor benefits of smart metering can be realised), and no improvement in billing because the supplier still has to manually read the meter.

Part III

The Anatomy of an Advanced Metering Infrastructure

In This Part

- Thinking about what's needed to support smart metering
- Communicating with a smart meter

Smart meters require different bits and pieces to support them and this part describes the major components required.

Home Display Units (HDUs)

Home Display Units (HDUs; referred to as *In-Home Display Units*) (IHUs) or *Customer Display Units* (CDUs) are the devices that you put on your wall or fridge to inform you about your energy consumption. Communicating wirelessly with the smart meter (either directly or via the Home Area Network which we explain in the following section), the HDU displays near-real time information on energy usage, cost and greenhouse gas generation for both gas and electricity. A common feature is a coloured light indicator to tell you when to run around switching things off!

It's fair to say that HDUs have a way to go to becoming the must-have stylish home accessory but it's only a matter of time . . .

Home Area Networks (HANs)

The *Home Area Network* enables devices and appliances to communicate with each other. The obvious example is the smart meter and the HDU. However, appliance manufacturers are becoming more and more savvy to the idea of home networking. The vision of a 'smart home', in which appliances, lighting, heating and security are connected and automatically controlled to save energy and improve occupant well-being, isn't far away.

Wide Area Networks (WANs)

What makes a meter smart is its ability to hold a two-way conversation with a data communication (or 'head-end') system. The medium over which this communication occurs is called the *Wide Area Network* (WAN).

Although, in principle, smart meters could have their own dedicated WAN, a number of communication infrastructures are already in place that are capable of fulfilling the WAN role. These include the copper and fibre networks of fixed line telephony providers, the cellular networks of the mobile phone operators, and the power lines of the electricity distribution networks.

Data Communication system

The data communication, or 'head-end', system is responsible for pulling together data from a large and disparate set of smart meters. It handles two-way communication, sending service requests to the meter and receiving messages such as scheduled meter readings. In order to communicate with a smart meter, a head-end system must 'speak' that meter's protocol. Unfortunately, there's currently no smart meter equivalent of Esperanto, so head-end systems need to be multilingual. Alternatively, a smart metering solution can use multiple head-end systems or stick with one meter manufacturer to standardise on a single protocol.

Meter Data Management (MDM) systems

Smart meters can produce a prodigious amount of data compared to their conventional cousins, which typically only record *non-interval data* (meaning data obtained only when someone manually reads it, usually once every three months). Smart meters, however, are capable of recording *interval consumption* (meaning consumption data automatically recorded at a predefined interval, typically every 30 minutes (in the UK).) So a smart meter can produce over 4,000 times as much data a year as its conventional counterpart.

An MDM system is a single repository capable of receiving, validating and storing the vast quantities of meter readings and other data associated with smart meters. It typically gathers data from one or more head-end systems.

Data portal

Gathering vast quantities of metering data is all very well but has little benefit unless that data can be transformed into valuable information and made available to those who will act on it. A *data portal* is the means by which the data collected in the MDM system is made available to whoever needs it – the customer, supplier, or distributor. Some MDM products also include data portal functionality.

How Do I Talk to a Smart Meter?

When industry types start talking about smart meters, the conversation inevitably turns to communication technologies. So here's a quick primer so that you can hold your own at the coffee machine.

You can communicate with a smart meter in a number of ways, each having its own advantages and disadvantages:

- **Power Line Carrier (PLC):** Also known as *Power Line Communication*, PLC technology carries data across the same power line that's used to deliver electricity. Meters talk to a smaller number of *concentrators* (communication devices) across the power lines. The concentrators then talk to the central head-end system via another communication technology such as GPRS (explained in a moment).

  The major advantage of PLC is that it's effectively free. Disadvantages are the need for concentra-

tors and the fact that, due to power lines being inherently noisy environments, communications often need to be repeated, leading to slower response times.

- **Broadband over Power Line (BPL):** Also known as *Power Line Internet*, BPL is the use of PLC technology to provide broadband through ordinary power lines. Using BPL, a smart meter can enjoy a virtually free, always-on connection to the central head-end system. However, as with PLC, BPL requires concentrators and is subject to line noise which often requires a large number of repeaters to boost the signal.
- **General Packet Radio Service (GPRS):** GPRS is a packet-orientated mobile data service that can be used to provide an always-on wireless connection between a smart meter and a central head-end system. GPRS uses a mobile operator's WAN and requires the smart meter to be fitted with a proprietary SIM card. Unlike BPL, the connection isn't free but is typically charged per megabyte of data moved. However, it can cope with large volumes of data (for example, when updating a smart meter's firmware).
- **Short Message Service (SMS):** Also known as text messaging, SMS involves sending fixed size text messages via a mobile operator's WAN using a SIM card installed within the smart meter. While SMS can have a broader coverage than GPRS, the fixed "short" nature of the message means that it is less suited to the transfer of large data volumes.
- **Radio:** Radio waves can be used to communicate with smart meters either locally (low power radio)

or long range (licensed or private frequency). Both require additional infrastructure (for example, concentrators and/or dedicated radio masts).

- **Wi-Fi:** *Wi-Fi* is the trade name for a popular wireless technology that enables a device to make a wireless connection to the Internet via an access point (or *hot spot*). The advantage of Wi-Fi is that it's relatively cheap to Wi-Fi-enable a smart meter. The disadvantage is the limited coverage of hot spots due to the fairly high power requirements.
- **ZigBee:** ZigBee is a low-cost, low-power wireless mesh networking standard. Like Wi-Fi, communication via ZigBee is cheap. However, it's best suited for local coverage such as Home Area Networks (HANs).

Keeping Smart Secure

The end-to-end security of the smart metering infrastructure, from smart appliances in the home to an energy company's IT systems, is a vital consideration in its design. Maintaining the public's confidence that their uninterrupted access to energy will not be affected and that their personal data remains secure is crucial.

Different parts of the end-to-end smart metering infrastructure have different types and levels of risk associated to them. The good news is that similar risks are faced and are effectively managed in other sectors today.

In many sectors, access to individuals' personal data held in IT systems is kept secure through a combination of technical and procedural measures. The telecommunications sector maintains the security of its

networks through controlling the types of devices that can be connected to their infrastructure through the definition of standards in Codes of Connection (CoCos). Devices are identified and securely connected with communication gateways or routers through the entry of security keys or codes. Many connected devices receive regular updates based on the pro-active identification of new threats.

A secure smart metering infrastructure will build on the learning of other sectors. CGI is drawing on the knowledge and experience of our Security practice to ensure that our clients and their customers can have confidence in the security of their smart metering solutions.

Part IV

Feeling the Impact of Smart Metering

In This Part

- Looking at the effect of smart metering on customers, suppliers and distributors
- Sharing success stories

Smart metering will have a profound effect on customers and the utilities that service them. Here, we consider some of these impacts through reference to real-life examples.

Impact on Customers

So, what impact will a smart meter have on your average customer?

Better informed

A key objective of smart metering is to make customers more energy savvy. The timely provision of detailed consumption information will empower customers to make smarter choices about how and when they use energy. Given the continued upward trend in world

energy prices, this empowerment is bound to appeal to customers and increase their expectations of the service they receive from their energy suppliers.

Better billed

A welcome customer benefit of smart metering is the demise of the estimated bill. Infrequent meter readings and poor access rates mean that many customers are more than often not billed on estimated, rather than actual, consumption. This can result in customers unknowingly running up significant debts and exacerbating the problem of fuel poverty.

Energy savvy Swedes

The 22,000 inhabitants of Växjö, a city in Sweden, are now more energy savvy thanks to an energy-efficient urban development project sponsored by the European Union (EU). Householders are now able to analyse their energy usage via a web-based system developed by CGI. The purpose of the system is to increase customers' energy awareness by making analysis simple and informative. The system includes a competitive element, enabling householders to compare consumption with peers and compete for prizes based on reductions in their energy consumption.

Ann-Mari Ståhlberg, President of Växjö Energi AB, said: 'With this solution, we're able to offer our customers something we always aim for, namely, the opportunity to influence and increase the efficiency of electricity consumption.'

(The project referenced in this example, and all examples in this book, was delivered by Logica, which CGI acquired in August 2012.)

Getting the bills right

Swedish legislation demands that all electricity meters must be read once every month. Energy company Vattenfall's solution to this challenge was to deploy smart meters to its customers and, with CGI as a key partner providing the Advanced Metering Infrastructure, has now installed over 150,000 smart meters.

Hundreds of thousands of meters reporting daily creates very high volumes of data. Despite these volumes, the system has exceeded its reliability targets, consistently running at levels well above 99.5 per cent of collected values in a 24-hour period. As a result, Vattenfall experiences higher levels of satisfaction among its customers and fewer calls querying bills, because the bills are based on up-to-date information. Furthermore, the system provides information about power outages and power return for each customer, creating a valuable quality control resource.

Erik Nordgren, Head of AMR Project Vattenfall Eldistribution AN Sweden said: 'There's no question that automated metering has helped us deliver better customer service.'

With smart meters, readings are available on-demand. Smart meters are typically read more frequently than a customer is billed. However, on-demand meter readings can also be taken in-line with a customer's billing cycle or a price change to ensure that every bill is based on actual consumption.

With smart meters, the only excuse for billing on estimated consumption is a faulty meter.

Better serviced

Smart metering provides suppliers with the tools necessary to better service their customers. With improved visibility of a customer's consumption behaviour, suppliers are able to deliver innovative service offerings, tailored to the needs of individual customer types. It's no longer a case of 'one size fits all'.

Bringing prepayment metering into the 21st century

Mention 'prepayment' to most energy retailers and they go pale. Prepayment meters are typically installed for customers who've had debt problems in the past. Unlike credit meters, prepayment meters require the customer to pay up front before consuming energy and can also be used to recover outstanding debts over a period of time. As such, prepayment customers are often perceived to be high cost, low value, and labour intensive - why would you want that type of customer?

Instant Energy, an innovative application of mobile technology to the prepayment market, has transformed prepayment customers into a profitable and desirable market segment.

Developed by CGI, Instant Energy is designed to replace existing prepayment metering technology, leading to reduced costs in serving prepayment customers, improved customer experience, and reduced fraud. The solution is an electricity and gas prepayment service based on SMS messaging and the Pay As You Go (PAYG) concept. The technology enables customers to add credit to their prepayment meter without needing smart-

(continued)

cards, keys, or tokens - and without necessitating the customer to leave their home.

Instant Energy won the British Computing Society 2005 IT Professional Award for Social Contribution in recognition of the increased flexibility and control it grants customers.

With smart metering, existing service offerings such as call handling, are improved. Call centre staff are able to communicate with the meter while the customer is on the phone and see the same information that the customer sees. This leads to faster calls and a higher proportion of first-time call resolution.

Impact on Suppliers

The impact of smart metering on suppliers will be massive. It will not only change the way suppliers view and engage with their customers, but it will also open a new battleground for retail competition.

Smarter processes

In 1998, customers could choose who they bought their energy from for the first time. While this new-found freedom passed many people by, the impact on suppliers was profound. Retail competition required a whole new set of industry processes, data flows, and IT systems. The change to the industry was monumental and, a decade later, many suppliers are still catching their breath.

The advent of smart metering represents the next major disruptive transformation to the retail market. Processes that previously took days or weeks to complete and involved many people from different organisations can now happen in near-real time via a self-service customer web portal. The potential for change is breath-taking and, many would argue, long overdue.

Smarter competition

Smart metering will create a new battleground for retail competition.

If a new supplier is unable to communicate with the smart meter of a newly acquired customer and is forced to replace it smart meters will represent an insurmountable barrier to retail competition. So the need to preserve retail competition is likely to force the adoption of interoperability standards and provide a level playing field in which all suppliers have access to the same basic smart meter functionality.

The vastly increased detail of consumption data available from smart metering will enable suppliers to understand their customers' behaviour far better. They'll be able to distinguish the 'early birds' from the 'night hawks', the students from the OAPs, and the couch potatoes from the socialites, just from their energy use. Having segmented their customer base as never before, successful suppliers will be those that can rapidly develop new innovative products tailored to specific types of customers.

A smarter way to change your tariff

As an example of the scale of process transformation likely to come about through smart metering, consider the humble tariff change. Today, changing your tariff almost certainly involves changing your meter. You call your supplier who calls the meter operator to make an appointment for the meter change and calls you back to confirm the appointment date. After going round this circle a few times, the meter operator turns up to change the meter and, if you're lucky enough to be in, you get a shiny new meter. The meter operator then informs everyone and his dog about your new meter and, if the gods are smiling, you start receiving bills based on your new tariff.

This process takes days, if not weeks, to complete, involves at least half a dozen parties, dozens of data flows, and is highly prone to errors. In the new world of smart, you could complete this process yourself, online, in minutes.

Innovative product offerings are likely to combine a number of elements such as:

- ToU tariffs.
- Block tariffs that have varying rates depending on the level of demand over a defined period.
- Working capital tariffs that have different rates depending on the level of credit or debt between the supplier and the customer.

Given that every supplier is likely to have access to the same basic smart metering functionality, differentiation will be done in the back office and will depend on a supplier's ability to assemble modular smart meter and

back office functions into a coherent, innovative product offering. However, a level playing field means innovations can be copied so success will hinge on speed to market.

The Smart Office

In order to compete in the smart retail market, CGI believes that suppliers will need a new Service Oriented Architecture (SOA)-based environment in which innovative products can be rapidly developed, deployed and managed by combining smart meter services, best-of-breed Off The Shelf (OTS) components and existing back office functionality. This environment, termed the 'Smart Office', will sit between a supplier's legacy systems and the Advanced Metering Infrastructure (AMI) used to communicate with the newly installed smart meters and will utilise business process management (BPM) to orchestrate the processes required to deliver new smart-enabled retail products.

Believing this environment essential to compete in a smart retail market, CGI has launched a Smart Office service in which suppliers can rent a 'hot desk' in a virtual Smart Office via a software as a service (SaaS) offering. Rented on a per meter/per month basis thus avoiding the need for CAPEX investment, the Smart Office service allows suppliers to get to grips with this new way of working and the technology that underpins it.

Coping with the transition

A smart metering rollout won't happen overnight. Even the most optimistic, aggressive rollout models will take a decade or more. During that time, suppliers will be faced with the prospect of supporting two distinct sets of processes – conventional and smart – and the associated IT that goes with them.

Although the number of smart meters will initially be small, a complete set of new, smart processes and supporting IT will be required from day one to service them. In the case of the conventional processes, it may well be a case of letting them wither on the vine. Alternatively, suppliers may look for 'sunset' options from niche providers willing to take on processing of conventional customers until such times as they smarten up.

Impact on Distributors

In common with suppliers, a significant proportion of processes currently performed by distributors will be impacted by smart metering.

Smarter processes

Early notification of network faults via 'last gasp' smart metering functionality (that is, the ability of a meter to send an alert on battery power following a power cut), should enable network faults to be located and resolved more quickly. However, this functionality may have an adverse effect on a distributor's *Customer Minutes Lost* (CML) performance (an industry measure of the scale of electricity outages) because the clock will start running at the time of the fault rather than the time that the fault is first reported by a member of the public.

Smart meters may also improve the resolution of interruptions by providing the ability to communicate with individual meters to determine their state. Similarly, the ability to read meters on-demand will help to resolve erroneous customer calls (where a house fuse has blown, for example).

A distributor's role in identifying and stopping energy theft is likely to be significantly improved through the receipt of unsolicited tamper alerts from smart meters.

Similarly, more detailed consumption data will ultimately enable distributors to measure energy lost during distribution rather than estimating losses using complex models. A more accurate understanding of losses will lead to more accurate bills, reduced reconciliation wash-ups, and greater revenue certainty.

Smarter billing

As with suppliers, distributors will have the ability to offer more innovative Distribution Use of System (DUoS) tariffs based on the greater detail of consumption data available from a smart meter. An increase in distributed energy may force a major re-think of the way in which distributors charge suppliers for use of their networks. DUoS tariffs are typically related to the amount of energy consumed by customers. However, an increase in microgeneration and heat technologies means customers will import less energy, resulting in lower revenues for the distributors. However, investment in new systems to control the two-way flow of energy is likely to increase the cost of maintaining a distribution network. So distributors' current cost recovery mechanisms are likely to require a major overhaul.

The smart grid

A smart grid is a transformed electricity transmission and distribution network that uses robust two-way communications, advanced sensors, and distributed computers to improve the efficiency, reliability, and safety of power delivery and use. Smart grids are increasingly being seen as essential to cope with disturbed generation, greater proportions of renewable generation, active networks and the increased loads associated with electric cars.

Energy networks need to become intelligent. Additional remote monitoring across the network will be required to feed data into predictive modelling that will enable distributors to actively manage two-way electricity flows (that is, electricity flowing both to and from a household) across the network. Two-way energy flows mean that isolating parts of the network for maintenance will become more complicated. New safety procedures will be required to ensure that field staff are protected from electrocution.

Smart down under

SP AusNet is an Australian electricity distributor with a network covering more than 600,000 meters across 800,000 square kilometres. SP AusNet has engaged CGI as the systems integrator across a number of its Advanced Metering Infrastructure (AMI) systems including SP AusNet's chosen Meter Data Management (MDM) system, EnergyIP from eMeter. Having proven its capability in the MDM space, CGI's systems integration role was later expanded to include the program management of upstream AMI components including the meter provision, meter installation, meter communications, communication network management systems (CNMS) and finally the meter management systems (MMS).

The depth and strength of CGI's AMI and smart grid capability is helping SP AusNet transform to a full smart meter network, which itself is a key foundation for a smart grid.

Smart metering will be an essential component of the smart grid, providing the distributor with detailed visibility of the low voltage network and providing the information required to enable distributors to manage the network effectively and support investment decisions.

In 2005, the SmartGrids European Technology Platform (ETP) for Electricity Networks of the Future was formed. SmartGrids (as it's known to its friends) aims to provide a shared vision for a European electricity network for 2020 and beyond. The SmartGrid must be flexible, accessible, reliable, and sustainable while remaining responsive to the rapidly evolving needs of its customers. SmartGrid's goal is to change the mindset of the industry into adopting new technologies, addressing real concerns over security and reliability and embracing the SmartGrid vision.

SmartGrids is backed by the work of IRED (Integration of Renewable Distributed Generation), a cluster of European projects with €35 million of EU funding and over 100 stakeholders from research, industry, and the utilities sector. CGI is an active participant in ETP.

Impact on Others

The impact of smart metering will extend beyond customers, suppliers, and distributors. Here are a few other parties who are likely to feel the effects of the transformation:

- **Meter manufacturers** will need to produce the tens of millions of meters required to smarten up the conventional metering infrastructure. However, suppliers will need to agree on a minimal level of smart meter functionality before the production lines can begin in earnest.
- **Meter operator numbers** will double or treble to achieve the aggressive timescales being set for smart metering rollouts. Dual-fuel sites will require either a new breed of multi-skilled meter operator or close co-operation between existing gas and electricity meter operators.
- **Data collection** will become a virtual activity as increasing numbers of smart meters are read remotely.
- **Data processors** will need to respond to the challenge of smart meters and the associated increase in data volumes.
- **Water utilities** with a 100 per cent metering policy (either due to water scarcity, leakage, or both) have the opportunity of piggy-backing on a gas/electricity smart meter rollout to accelerate their metering programmes and/or deliver them at reduced cost.

Part V

Looking to the Future

In This Part

- Delving deeper into microgeneration
- Living in a smart home

Smart meters aren't going to magically appear overnight. Even the most aggressive rollouts will take years, if not decades, and the world at the end of a smart metering rollout will be very different from that at its start. In this part, we look at some of the parallel activities that will influence, or be influenced by, a widespread rollout of smart metering.

Creating a Buzz in Your Own Backyard: Microgeneration

The introduction of microgeneration (households producing electricity from, for example, solar panels) will fundamentally change the relationship between customer and supplier. No longer a one-way transaction of the customer paying the supplier for delivered energy; the 'prosumer' will also sell to the supplier and take on the role of a trading partner.

Microgeneration has a huge potential to minimise transmission and distribution losses and offset some of the impending energy gap threatened by an aging generation plant and an inexorable increase in demand.

For microgeneration to flourish, it needs improvements in technology, a system of financial reward, and, not least, a means of measuring the power generated.

Significant growth in microgeneration will present challenges to distribution network operators who will now need to manage active networks (those in which electricity can flow to and from a customer).

Distributed generation will meet demand locally but less predictably, increasing the challenge of scheduling the central generation plant effectively by the system operator. Demand is likely to become more volatile, increasing the challenge faced by suppliers and traders in forecasting wholesale demand.

Smart meters, with the capability of measuring export in addition to consumption, form the key enabler of this microgeneration revolution.

Home, Smart Home

Imagine arriving home from work. As soon as your digital key unlocks the door, your house adjusts the lighting, heat, and window blinds to your liking and puts on your favourite music in the kitchen. In your absence, the house has fed the cat, ordered more milk, turned off the TV that your kids left on in the morning, and kept electronic vigil over your property.

And that's not all. In response to an updated half-hourly tariff from your energy services company, your house

has turned off your freezer and fired up your fuel cell microgeneration unit to sell power to the grid.

A bit far-fetched? Just think of how homes have changed in the last five years.

For this scenario to become a reality, technology needs to elevate the customer from operator to strategist. The customer takes the strategic decision to adopt a smart tariff and technology takes responsibility for delivery. In this type of set-up, where you no longer need to think about when to run the washing machine or dishwasher, half-hourly tariffs become feasible with profound implications for both wholesale and retail energy markets. Yet this vision is only conceivable in a world with smart metering.

Smart electric car charging

A large energy distribution company in the Netherlands made a strategic decision to invest in electric driving and approached CGI to propose a solution for the charging stations essential to make the project work. The charging solution needed to be safe, simple to use, robust and reliable.

CGI proposed an innovative solution using a mobile device or card with RFID technology to initialise the charging station and provide usage feedback. The charging station itself contains an energy meter and communicates via GPRS with a central back office system that handles customer billing.

The benefits received by car owners include receiving feedback on the charging status of their cars via SMS, being able to locate a charging station and view charging history via their mobile phone and the capability to support international roaming.

Smarter Settlement

The energy consumed by a supplier's retail customers must be purchased on the wholesale market. The process by which suppliers settle for their wholesale purchases is likely to experience a transformation triggered by smart metering.

Wholesale purchases are settled for on an interval basis typically every hour, half hour or 15 minutes. *Interval customers* are those that are sufficiently large to warrant their consumption being metered on an interval basis. *Non interval customers* are those with smaller consumptions that don't warrant the expense of a half-hourly meter. For these customers (the majority of people), a system of profiling is often used to turn infrequent meter readings into estimates of interval consumption so that it can be settled on the wholesale market. This process is called *settlement*.

As suppliers learn more about their customers through the increased detail of consumption data provided by smart meters, their product offerings will expand as they identify and target specific types of customer. Some of these products will be designed to encourage behavioural change through innovative lifestyle tariffs. However, for suppliers to realise the benefits of the changes in customer behaviour that they've brought about, these changes need to be recognised in settlement.

In many cases, it may be feasible to model new customer consumption behaviours using existing Time of Use provisions. Thus enabling a proliferation of new smart retail products.

However, the advent of smart homes and increasing alignment of retail tariff structures with wholesale prices is likely to encourage suppliers to move their customers into the interval settlement process where they'll settle for their customers' consumption on an interval basis. In some markets, barriers currently prevent this from happening but none are insurmountable.

A mass migration of domestic customers from non-interval to interval settlement processes will see an explosion in data volumes because annual half-hourly settlement of an unrestricted customer requires over 4,000 times as much consumption data as is now the case. While the central settlement systems will be insulated from these volumes by data aggregation, the settlement agents will be faced with a profound challenge.

Smarter Balancing

Keeping the lights on is the job of the system operator who must ensure that exactly enough electricity is generated to meet demand on a minute-by-minute basis. In the event of unexpected demand or unplanned outages of a generation plant, the system operator invariably turns to the generators to provide the flexibility required to restore the balance between demand and generation. Market mechanisms do exist to allow suppliers to contribute to the balancing process but these have rarely been used.

With the better visibility and control over their customers' consumption provided by smart metering, suppliers will, for the first time, have the tools necessary to actively participate in the balancing process and realise the financial benefits this offers. This won't

happen overnight. Nor will it apply to a supplier's entire customer base, but there are customers out there with predictable, interruptible loads who could be helping the system operator to keep the lights on. But it's not just the suppliers who'll want to use this new found flexibility. While domestic demand side management offers suppliers a new revenue source, distributors will want to access this to better manage their networks. Actions taken by suppliers for short-term financial gain may not be in line with a distributor's long-term investment decisions. Similarly, actions taken by distributors to protect their network may put suppliers out of balance. And nothing's stopping third parties offering customers balancing services directly to transmission and/or distribution companies, independently of the supplier! While smart metering can physically enable domestic demand management, it's clear that new commercial and regulatory arrangements are also required.

Part VI

Top Ten Smart Tips

This part is small but packs a punch! Here are our top tips for surviving and thriving in the smart world.

Firstly, some general pearls of wisdom:

- **Think of smart metering as an opportunity, not a threat.** Smart metering *is* coming and the successful companies will be those that embrace the technology.
- **Think about the process, not the meter.** To date, a lot of attention has been focused on the box on the wall but it's time to start thinking about how to transform your business to exploit the opportunities that smart metering will enable.
- **Remember that rollout must be watertight.** The rollout of smart metering offers a unique opportunity to address long-standing, acknowledged data quality issues in the energy sector – but only if we get the rollout right!
- **Smart won't happen overnight, so be prepared for the long haul.** Even the most aggressive rollout models are likely to take a decade or more – be prepared to continue to support your conventional processes alongside your smart processes or, alternatively, look for sunset options.

- **Learn from others.** Look to countries that are further down the smart road, like Italy, the US, and the Nordic countries, and learn from their experiences.

Here are our tips for the energy suppliers:

- **Use smart meters to get closer to your customers.** Smart metering offers a unique opportunity to better understand your customers' energy needs – so use it!
- **Be prepared to be different.** The successful smart supplier will be the one that can rapidly translate customer insight into innovative product offerings. Make sure your IT systems are ready for the challenge!
- **Differentiate in the back office, not the meter.** Innovations within the meter belong to everyone because everyone is likely to have access to the same basic smart metering functionality. Innovations within your back office are yours alone.
- **Get ready for data – and lots of it.** Better customer insight comes from more detailed consumption data. Ensure you have the systems to handle vastly more data than you do today.
- **Remember that customers are people too!** The transition from conventional to smart meters will be exciting and disruptive, not least for the customer. Make sure you have adequate information and support in place to help them through the transition.

Glossary

- **AMI:** Advanced Metering Infrastructure. The hardware, software, and communications infrastructure required to support smart metering.
- **AMR.** Automated Meter Reading. The ability to remotely read a meter.
- **BPL.** Broadband over Power Line. The use of Power Line Carrier (PLC) technology to provide broadband through ordinary power lines.
- **CHP.** Combined Heat and Power. The use of a heat engine or power station to simultaneously generate both electricity and useful heat.
- **CDU.** Customer Display Unit. Another term for Home Display Unit (HDU).
- **Clip-on meter.** A low-cost sensor that attaches inline with the existing conventional electricity meter and sends consumption data to a wireless monitor elsewhere in the house, showing customers how much electricity they're using in near-real time.
- **CML.** Customer Minutes Lost. An industry measure of electricity outages experienced by customers.
- **Concentrator.** A device required to support Power Line Carrier (PLC) communi-

cation between the head-end system and PLC-enabled smart meters.

- **DUoS.** Distribution Use of System. The charges levied by the distributor on the supplier for use of the distributor's network in supplying the supplier's customers.
- **ERA.** Energy Retail Association. An organisation representing the major electricity and gas suppliers in the domestic market in Great Britain.
- **Firmware.** A computer programme embedded in a hardware device.
- **GPRS.** General Packet Radio Service. A packet-orientated mobile data service that can be used to provide an 'always on' wireless connection to a smart meter.
- **HAN.** Home Area Network. A network within the home that enables devices and appliances to communicate with each other.
- **HDU.** Home Display Unit. Also known as In-Home Display Units (IHDs) or Customer Display Units, these devices communicate with smart meters, either directly or over the Home Area Network (HAN), to display energy-related information to the customer.
- **Head-end system.** The central component of an Advanced Metering Infrastructure

(AMI) that communicates with smart meters in the field.

- **IHD.** In-Home Display unit. Another term for Home Display Unit (HDU).
- **MDM.** Meter Data Management. A single repository of meter-related data (billing, settlement, demand forecasting, and so on) that can gather data from multiple head-end systems and make this available to multiple applications.
- **Microgeneration.** The production of heat and/or electricity on a small-scale.
- **PLC.** Power Line Carrier. Also known as Power Line Communication, this is a technology used to carry data across the same power line that's used to deliver electricity.
- **Prosumer.** A customer ('consumer') who also generates electricity ('producer') from microgeneration.
- **SIM.** Subscriber Identity Module. A smart card that stores data for GSM cellular telephone subscribers.
- **SMS.** Short Message Service: a low cost, message-based alternative to voice calls that can also be used by a head-end system to communicate with SMS-enabled smart meters.
- **Smart Grid.** A transformed electricity transmission and distribution network that uses robust two-way communications,

advanced sensors, and distributed computers to improve the efficiency, reliability, and safety of power delivery and use.

- **Smart Home.** A home in which systems (appliances, lighting, heating, air-conditioning, and so on) are connected and remotely controlled over a Home Area Network (HAN) to save energy and improve comfort, safety, and convenience for the occupants.
- **SOA.** Service Oriented Architecture. A software architecture where functionality is grouped around business processes and packaged as interoperable services.
- **ToU.** Time of Use. The ability to record *when* a customer uses energy in addition to *how much* they use.
- **WAN.** Wide Area Network. In the context of smart metering, the WAN refers to the communication infrastructure used to communicate between the smart meter and the central data comms ('head-end') system.
- **Wi-Fi.** The trade name for a popular wireless technology that's increasingly common in home networks, mobile phones, and video games.
- **ZigBee.** A low-cost, low-power wireless mesh networking standard that's becoming an emerging benchmark for Home Area Networks.

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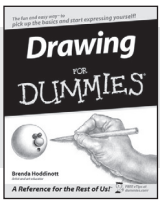

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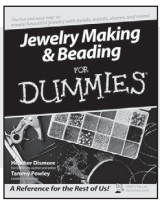

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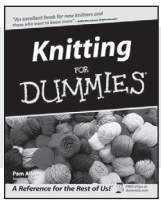

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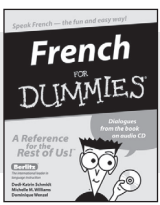

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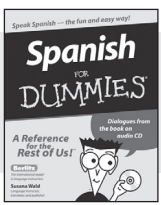

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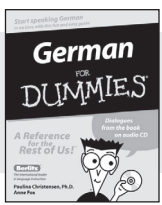

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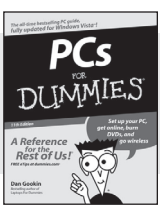

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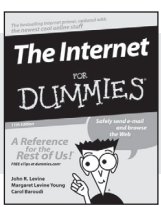

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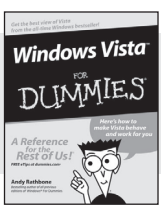

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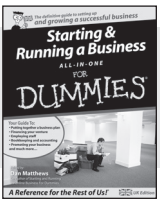

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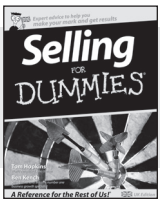

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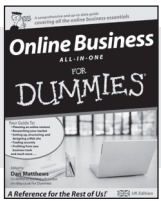

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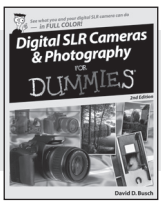

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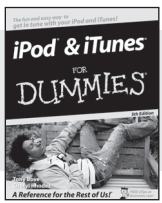

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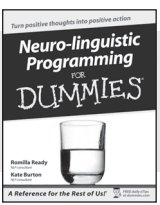

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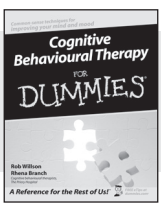

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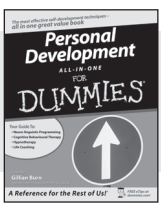

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