Smart Meters

Technology Review and Role in the Western Cape

2013-2014

Report Prepared for:
Department of Economic Development and Tourism
Western Cape Government

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EXECUTIVE SUMMARY

Smart metering uses communication technologies and electronic energy meters to meter energy usage and communicate with a system in the utility. Smart metering provides two way communications between the utility's meter management system and the smart meters on the grid.

Smart meters enable multiple benefits to utilities, their customers and the environment; however there are many public concerns with the technology and challenges that must be faced by utilities moving towards smart metering.

Smart metering offers the utility the following benefits:

- Eliminating manual meter reading, improving accuracy.
- Distributed Generation
- Peak Load Reduction
- Avoiding capital expense
- Increased efficiency and reduced energy losses
- Real-time data for network monitoring
- Making it possible to use power resources more efficiently
- Demand Response
- Energy balancing
- Theft Prevention
- Synergy with a Smart Grid

Smart metering also benefits the utility's customers by providing:

- Feedback on energy usage
- Reduction of customer bills
- Reduction of blackouts
- Lower long term pricing

Environmentally smart meters help reduce greenhouse gases through energy efficiency and enabling renewable generation.

Some challenges utilities face when implementing smart meters include:

- High hardware costs
- Transitioning to new technology and processes

- Managing public reaction and customer acceptance of the new meters
- Managing and storing large volumes of data
- Ensuring security in the system

Public concerns have been raised about:

- Job Losses
- Increased bills
- Health impacts of smart metering
- Privacy and Security

There are many concerns that still exist over smart meters, and not all of them will be addressed through the evolution of the technology. Despite concerns, smart meters form an integral part of a smart grid, and are being widely deployed around the world and are likely to improve as the technology continues maturing.

LIST OF ABBREVIATIONS

AMEU	-	Association of Municipal Electricity Utilities
AMR	-	Automatic meter reading
IDP	-	Integrated development Plan
MFMA	-	Municipal Finance Management Act
SALGA	-	South African Local Government Association
SASGI	-	South African Smart Grid Initiative
SCM	-	Supply chain management
SCMP	-	Supply chain management policy
SG	-	Smart grid
SM	-	Smart meter
T&D	-	Transmission and distribution (electrical)
WCG	-	Western Cape Government

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GLOSSARY

Advanced metering infrastructure (AMI)	AMI is a composite technology composed of several elements: consumption meters, a two-way communications channel and a data repository (meter data management). Jointly, they support all phases of the meter data life cycle — from data acquisition to final provisioning of energy consumption information to end customers (for example, for load profile presentment) or an IT application (such as revenue protection, demand response or outage management) (Gartner, 2014).
Asset management	In the context of electrical infrastructure, this is the process of recording data in an asset accounting system about an electrical asset. The level of detail depends on the requirements – it could include: asset description, age, value, geographical position (GPS coordinates), address, associated business name and contact details, service history, fault history etc.
Automated meter reading (AMR)	The capability of reading meters remotely and automatically using smart meter telecommunications and storing this data in a billing or accounting system.
Carnegie-Mellon Smart Grid Maturity Model	This is a tool for assessing an electricity utility's progress towards a smart grid implementation (Carnegie Mellon, 2014).
Condition monitoring	As applied to electricity grid infrastructure, condition monitoring includes monitoring and recording of equipment operating conditions such as temperature, voltage, current, vibrations, operational changes (e.g. switch operations, tap-change operations).
Conventional or non-smart meters	These are meters that are essentially stand-alone and can't be read or updated remotely. That is they have to be physically read and updated
Detent	In the context of electricity meters, a detent is a facility in a meter that prevents the meter from measuring reverse energy, e.g. when site is generating more power than it consumes. A detent can be a

mechanical ratchet-like device or a meter software feature.

Energy balancing	The process of measuring the energy supplied and consumed within a defined area so as to identify missing energy (e.g. due to electrical losses, theft or incorrect metering).
NRS 049, 049-2, 049-3	A South African specification for smart prepayment metering systems (CTES, n.d.; SABS, 2008).
Pre-paid meter	An energy meter that can accept payments for electricity, usually through a key-pad, apply a stored tariff and keep a running total of the amount of energy credit remaining.
Revenue protection	Processes and systems put in place to minimise the loss of electricity sales revenue due to theft and inaccurate metering and billing.
Smart grid	A Smart Grid is an electricity network that can intelligently integrate the actions of all users connected to it – generators, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure electricity supplies (definition from the European Technology Platform Smart Grid).
Smart meter	A meter that measures energy consumption (in this report) over specified intervals, has two-way communications capability, stores metering data in registers, supports a variety of tariffs (e.g. time of use, inclined block, maximum demand, free basic electricity) which can be remotely updated, can switch attached loads on command and interfaces to data concentrators.
Smart meter communications (or telecommunications)	A smart meter has to be able to communicate with other devices, such as a data concentrator, for the purpose of transmitting data such as meter readings, tamper alarms, or for receiving data such as tariff updates. The communication is usually by Wifi or cellular GPRS or by power line carrier (PLC).
STS	Standard Transfer Specification. “STS is a secure message system for carrying information between a point-of-sale and a meter, and is currently finding wide application in electricity metering and payment systems” (STS Services, 2014). It is commonly used to support a coupon-based payment method for pre-paid meters. One buys a coupon from a vendor and enters the code into the pre-paid meter

	which then credits one with the number of units purchased.
Supply chain management (SCM)	A set of processes designed by the National Treasury and backed up by legislation, which controls how government entities carry out their procurement of goods and services.
Tamper detection and protection	Preventing and detecting attempts by customers to cause meters to under-read energy usage.
Vending and billing	The process of selling and dispensing electrical energy and accounting for it.

1. INTRODUCTION

Smart metering uses communication technologies and electronic energy meters to meter energy usage and communicate with a system in the utility. Smart metering provides two way communications between the utility's meter management system and the smart meters on the grid.

Smart meters enable multiple benefits to utilities, their customers and the environment; however there are many public concerns with the technology and challenges that must be faced by utilities moving towards smart metering.

In this document we will discuss the benefits, functionality and challenges surrounding smart metering.

2. SMART METERING BENEFITS

Smart metering provides multiple benefits to both the utility and the customer. In this chapter we will split the benefits into two primary categories, namely customer benefits and utility benefits. As part of the municipal mandate is to provide customer service, the benefits to the customer are also in the municipality's best interests and could be considered as benefits for the municipality. Similarly as the municipality is run to provide services and not earn profit, savings and benefits to the municipality also indirectly benefit the customer; however for the purposes of this document we separate the benefits based on the party that gains the direct benefit.

2.1 Utility Benefits

Eliminating manual meter reading, improving accuracy.

Smart meters are equipped with two-way communications; this allows them to automatically return readings to a central Meter Data Management (MDM) system. This provides an advantage over regular mechanical disk meters as there is no need for a meter reader to manually visit the meter to get a reading. Removing the human interaction in the meter reading drastically speeds up the process and removes the chance of human error in collection of the reading. The removal of meter readers does have some negative side-effects, such as losing the visual inspection provided by meter readers.

Distributed Generation

The energy industry is currently moving away from conventional fossil fuel based energy sources such as coal, and towards cleaner, low carbon forms of generation (Hamidi, et al., 2010). Renewable energy sources such as photovoltaic (solar) and wind generation are being implemented at locations close to load centres. This type of generation which is connected directly to the distribution network of on the customer side of the meter is known as distributed generation (DG) (Ackermann, et al., 2001).

Conventional electricity generation, transmission and distribution networks were designed to have power coming from known sources. When power is generated at other points, the system will not always behave as designed. Distributed generation, which can include multiple, unmanaged generation sources, causes a number of concerns for the utility managing the distribution grid, including issues over safety, power quality and revenue loss. Smart metering can help a utility to better manage the concerns of distributed generation. As part of a smart gird system, the information from smart meters can be used to help manage distributed generation.

Network concerns

Distributed generation has an impact on the distribution network, and can impact losses, voltage control, power quality, short circuit power, and system protection (Ackermann & Knyazkin, 2002). Smart metering can provide essential information to the utility to help it better manage impact of distributed generation on the distribution network.

Renewable generation is not as predictable as fossil fuel energy sources, and because of this managing a grid with renewable generation can be difficult. Smart meters can provide real time information on the generation that is currently active, and the energy on the grid. This information may be difficult for an individual to handle, but when smart meters are combined with a full smart grid, it is possible for the grid to automatically manage and react to distributed generation.

Net Metering

While smart metering can aid with some power quality when combined with a smart grid system, its most direct effect on distributed generation is related to billing. Customers with generation devices that generate more energy than the customer is using will be exporting power to the grid. With conventional mechanical disk meters the outcome of the customer exporting electricity depends on the existence of a detent on the meter. If the meter is equipped with a detent, the customer will not receive any benefit from exporting energy as the meter will only record in one direction. Without a detent, the meter will simply spin in the reverse direction when the customer is exporting electricity; this means that when the customer is exporting electricity to the grid, it is being “bought” by the utility at the utilities sale price. Meters running in reverse can also cause administration problems for the utility, because, if the meter reading is lower than the previous one, the system will assume that the user has rolled over the meters maximum reading, resulting in a large, inaccurate bill.

Smart meters allow the utility to separate the energy consumed from energy generated, thereby removing the issues of customers exporting electricity at either no value, or at selling price. The utility is able to bill the customer for power used at a different rate to what it pays the customer for generation, thus greatly reducing the losses seen by the utility. Smart meters also remove the ambiguity that can occur when meter readings are lower than previous readings as they track the direction of power flow.

Smart meters offer many options to the utility in terms of how the customer is billed when also generating. The utility may wish to completely separate generation from consumption, or only bill the user for the difference. The key addition is that the smart meters provide is the ability for the utility to choose a billing method that best suits their situation.

Peak Load Reduction

Through the implementation of smart metering functionality such as Time-of-Use (TOU) billing and dynamic pricing a smart metering system encourages users to reduce loads at peak times. Increased pricing when the distribution grid and generation is under the most strain serves as a deterrent for continued heavy power usage. If users continue to use power in peak times, their bills will increase and the utility will generate more revenue to compensate. If the users shift their loads out of peak times, their bills will decrease. This decrease in bill for the user does not however always translate into a reduction of revenue for the utility. Because the utility is most likely buying power at a time of use rate itself, the user moving load out of peak time also reduces the utility’s costs. When offered savings of 10% on their electricity bills customers have been noted to reduce peak load by up to 15% (Najjar, 2013).

In a situation where the utility is paying for energy at a TOU rate, but billing the customer at a flat rate, it is likely that the utility is making a loss in peak times (as can been seen in most Western Cape municipalities during winter).

Benefits of reduced peak load

Additional income from tariffs is not the only way that municipalities can benefit from a reduction in peak load. Additional benefits include reductions in capital expenditure, reduced, increased efficiency and reduced energy losses. These benefits will all be considered separately as individual smart meters benefits, despite the fact that they are all effectively achieved through the same mechanism.

Avoiding capital expense

The reduction of peak loads that can be achieved through time of use billing mentioned in chapter 0 can decrease required capital expenditure significantly. Grid reinforcements that are required when a network is running at close to its maximum capacity can be avoided by reducing the demand on the grid.

Increase efficiency and reduced energy losses

The reduction of peak loads that can be achieved through time of use billing mentioned in chapter 0 also means that energy efficiency is increased because resistive losses on the network scale with the square of the current. This means that flattening out the load peak increase the network efficiency by reducing technical losses.

Real-time data for network monitoring

Smart meters can provide the utility with up-to-the-minute information on the status of energy flow on the network. When information from smart meters is gathered and combined in a meter data management system it can provide a wealth of information to the utility which can be used to better understand the power flows within the network. This information can also be used to help prevent blackouts.

Making it possible to use power resources more efficiently

The knowledge gained from smart metering allows the utility to make decisions based on accurate information. Armed with increased knowledge of power flows, the time of power consumption and quality of supply information, the utility can make sure that it chooses the best possible use for the resources it has available.

Demand Response

Smart metering systems offer municipalities new options for demand response. Connecting interruptible loads (loads which can be turned off without issue) to the network allows the utility to respond to situations where the demand is too high for the supply to handle.

Energy balancing

Energy balancing involves comparing the energy used by the customers connected to a substation with the energy measured as passing through the substation. In a lossless system the sum of the energy used by all customers should match the energy passing through the substation. In reality this is not a lossless situation, and the totals will not match exactly. The difference in totals represents the losses in the system between the substation and the customers. If these losses are unexpectedly high there is most likely a problem such as electricity theft, or poorly calibrated meters.

Theft Prevention

Non-technical losses, particularly theft has been increasing across all sectors resulting in increased energy losses (Eskom, 2013). One of the benefits of smart meters is that they can be used to detect theft, particularly when combined with energy balancing. Large sudden changes in customer's electricity usage patterns, or irregular usage could be an indication of theft.

With conventional meters it is impossible to tell when power was being used and the meters have no way to communicate to the utility, whilst smart meters let the utility know when and how power is being used, as well as being able to send an alert to the utility if they notice they have been tampered with.

Synergy with a Smart Grid

While smart meters have many benefits when implemented alone, it is only when they are part of a full smart grid that their full potential can be unlocked. Smart meters improve the impact of other grid implementations, such as outage management systems.

2.2 Customer Benefits

Smart metering also offers benefits to the utility's customers.

Energy Use Feedback

Utilities can offer customers detailed feedback on their energy use. Customers are able to see exactly when they are using the most energy, and what it is costing them. If real-time feedback is offered by the municipality the users will be able to instantly see the effect of their actions. If the users turn on heaters they will be able to see how much their consumption is increased and know what it is costing them, similarly they can see the amount that they can save by powering down devices

Bill Reduction

Through the use of time-of-use billing users are able to reduce their energy bills by changing when they use energy. Moving loads outside of peak times can give customers a significant reduction in their bills.

Reduced blackouts, and lower long term pricing

By reducing the maximum demand on the electricity networks, customers will benefit from reduced need for load shedding. A stable healthy electricity network benefits the customers just as much as it does the utility. In the long term, the higher costs of peak generation will filter down to the customers. If the peak load is reduced it can prevent the need for expensive capital investments by utilities, and thus keep the long term price down.

2.3 Environmental Benefits

Increased grid efficiency and reduced need for fossil fuel based generation will benefit the environment. Increased grid efficiency means that less energy is wasted and can help reduced the greenhouse gas emissions of existing power plants. Moving away from high peak usage removes the need to run the peaking generators (open cycle gas turbines).

Enabling renewable energy production through distributed generation reduces the need for new coal or nuclear power plants and replaces them with more environmentally friendly options.

3. LOCAL CONTENT

There are companies in the Western Cape manufacturing smart meters which can provide jobs and income for the Western Cape. The local content is examined in more depth in the Green-Cape report “Smart Meters Survey - Localisation and roll-out barriers”.

4. FUNCTIONALITY OPTIONS

Smart meters provide different functionality options to the utility, the utility can choose to have meters implement as many or few of these functions as they want.

4.1 Time of Use

Smart meters allow the utility to bill its customers based on the time of day at which energy is used. This is important to utilities as the cost of energy generation is not fixed throughout the day. The higher the demand for electricity, the higher the cost of generation.

4.2 Dynamic Pricing

Dynamic pricing allows the utility to bill its customers at a rate that is dependent on the current load. As the load increases or decreases, so does the cost of energy. This is used to encourage customers to use electricity when demand is low, and reduce consumption when demand is high. This is similar to standard time-of-use billing, however it does not have fixed times at which energy is priced at a premium, but is rather based on the current demand. Dynamic pricing helps ensure that the peak is not simply shifted to a new time, as if everyone moves load to the same time slot, the pricing in that time will also increase.

4.3 Bi-directional Metering

As described in chapter 0, smart meters allow the utility to measure not only the total energy flow through the meter, but also the direction in which the energy was flowing. This allows utilities to have different pricing for consumption and generation.

4.4 Home Area Networking

Smart meters with home area networking (HAN) allow devices within the home to communicate with the meter. This allows the devices to get tariff information that will allow them to schedule their loads so as to minimize the bill to the customer. This works well with dynamic pricing as devices such as water heaters or refrigerators can time their active cycles to be during the lowest cost periods, and suspend their activities if the price is currently high.

5. COMMUNICATIONS TECHNOLOGY

The communications platform on which a smart metering/smart grid is based forms the foundation upon which all systems are built. There are multiple different technologies that fall into this category. For the purposes of this paper we will divide them into two primary groups, physical communications, and communications software.

Some of the more popular physical smart grid communications technologies include: Zigbee, GSM (Global System for Mobile), LTE (Long Term Evolution), DSL (Digital Subscriber Line), Fibre Optics, RF (radio frequency) and PLC (Power Line Communications). These physical technologies all have various advantages and disadvantages, and the choice of which technology is often determined by the individual requirements of the project. It is possible that the best communications platform for a smart grid implementation may use multiple physical communications technologies throughout. In Table 1 a comparison is given between some of the physical communications technologies. The physical technologies are generally well understood and there are very few standards issues arising from the chosen physical system.

Table 1. Smart grid communication options comparison (Sörries, 2013)

Parameter	GSM at 900 MHz	LTE at 800 MHz	CDMA at 450 MHz	Fiber optics	DSL	Power line
Scalability	Competition on resources	Competition on resources	No competition on resources	No competition on resources	No competition on resources	No competition on resources
Low latency	No	Yes	Yes	Yes	Yes	Narrowband no
Data rates are sufficient	Problematic	Yes	Yes	Yes	Yes	Narrowband no
Enhanced Resilience	Not available	Not available	Available	Available	Only limited SLAs	Not available
Indoor penetration/ availability	Fair	Fair	Good	Good	Good	Good
System availability	Constrained	Constrained	Yes	Yes	Yes	Constrained
Network and system optimization for M2M applications	No	No	Yes	No	No	No
Interference with other services (e.g. broadcasting)	No	No	No	No	No	Expected
Cost effective nationwide coverage available/possible	Yes	Yes	Yes	Very limited	Partially limited	Limited
Installation / rollout	Simple	Simple	Simple	Difficult	Difficult	Simple
Security	Public Grid	Public Grid	Closed Network	Public grid	Public grid	Closed network
Long-term system availability	No	Yes	Yes	Yes	Yes	Yes
Exposure to customer behavior	No	No	No	Yes	Yes	No
Exposure to developments in the broadband market	no	Yes	No	No	Yes	No

The "communications software" section of the coms platform refers to everything refers to the choice of protocols and standards that are implemented on-top of the physical communications. There are many different options available for the implementation of smart metering, ranging from proprietary systems to completely open systems. There is still much room in this area for improvement of standards to allow various smart meters and smart grid implementations to be interoperable.

One area where research has been focussed on is in machine to machine (M2M) communications. If an open M2M standard would be adopted by the smart grids industry it would allow all devices on the grid to be able to communicate to each other.

There does not currently exist any technology that is an accepted industry standard for all smart metering purposes, and as such the coms platform must be carefully selected for each implementation.

6. CHALLENGES AND CONCERNS

Smart metering provides the utility with many challenges to face, and the public with multiple concerns around this new technology.

6.1 Implementation Challenges

Smart meters present these challenges to the utility:

Cost of Hardware

The cost of Smart Metering technology is generally significantly higher than conventional or pre-paid meters. Municipalities in South Africa say they are paying anywhere between R1 500 and R8 500, in contrast a pre-paid meter can cost them as little as R400. A large part of this increased cost comes from the addition of a communications unit that allows the meter to communicate to the system.

This increased cost limits the viability of smart metering for many customers, as it can be difficult to justify the expenditure on meters when there are other pressing demands on the utility, such as electrification.

As the costs of smart meters and related communications decreases, the viability of smart metering increases.

Transitioning to new technology and processes

Implementing smart meters means new technology and new processes throughout the utilities metering revenue chain. Technicians must be trained to install and repair new meters. The utility will need someone capable of managing the new metering system, and troubleshooting issues that may arise.

Managing public reaction and customer acceptance of the new meters

Customer interaction is a key point to the success of a smart metering project. If the public is not properly informed the project is unlikely to be successful. Smart metering relies on the customers changing their usage patterns in order to reduce peak loads, this will not happen if the customers do not understand the new system.

Managing the public's opinion of smart meters and their understanding of why the meters are being installed will help reduce negative feedback from customers.

Managing and storing vast quantities of metering data

Smart meters generate an incredible amount of data when compared to the metering data available from conventional meters. Conventional meters are normally read once a month and only a kWh reading is taken. Smart meters can be read every 5 minutes and the full usage profile of the customer can be read. This increased information can be incredibly useful to the utility, but only if is properly managed, stored and interpreted.

Ensuring security

Increased amounts of data also means an increased security risk if the data is lost, stolen, or tampered with. Without appropriate security measures skilled individuals would not only be able to access metering data, but also alter the meters configuration and send commands over the network (Naone, 2009).

6.2 Public Concern

Despite the multiple benefits offered by smart metering, smart meters have not always been met with sentiments of praise and exultation. Multiple public awareness groups and websites such as stopsmartmeters.org and MSMA (Maryland smart meter awareness) have formed and raised concerns about the implementation of smart meters.

Job Losses

Concerns exist over the loss of the job of meter readers when smart meters are installed (Anon., n.d.). If meter readers are not reallocated to new jobs there could be significant repercussions for the utility implementing smart meters.

Increased Bills

Billing concerns and complaints come from two primary sources, namely inaccurate billing and bills increased drastically through the use of time of use billing. There have been multiple reports of customers being overbilled since they have had smart meters installed (Anon., n.d.) (Anon., n.d.). In some cases overbilling has been determined to be caused by faulty meters, but it is also likely that the overbilling is merely a result of increased bills due to TOU billing (Anon., n.d.).

Time of use billing increases the cost of energy during peak times; this price increase can translate to a large increase in overall bill for users that use most or all of their energy during these times. This large increase may be blamed on inaccurate meters.

Another concern is the idea “Smart Electricity Meters use power”, this concern is mostly due to poor education.

Health Concerns

Most health concerns exist around the use of wireless technology for the smart meters communication systems. Customers are concerned that utilities are installing a device which is hazardous to their health on their property without their consent (Anon., n.d.) (Anon., n.d.). The lack of knowledge of the long term effects of microwave frequency radiation, especially around the cause of brain cancer, are a great concern for many people. One of the common communication methods used is cell communication, and as such smart meters get all the health concerns of cell communication lumped on them.

Reports of wireless technology in general worry users who have had smart meters installed.

Privacy and Security Concerns

Public groups have expressed concern about the loss of privacy that they believe comes from smart metering with statements such as:

"When a 'smart' meter is installed, your utility has access to a treasure trove of information about your electricity usage, compromising your privacy" –stopsmartmeters.org

The public concern does not just end with privacy, concern also exists at the possibility of this knowledge being a threat to personal security; worries are that detailed knowledge of when users are at home may be a serious security threat.

7. CURRENT POLICY – REGULATION 773

7.1 Requirements

Regulation 773 of the Energy Regulation Act describes norms and standards for reticulation services that must be maintained and are described as necessary “to maintain a good quality of supply, to ensure stability of the electricity network, to minimize electricity load shedding and to avoid blackouts”. The regulation covers energy efficient lighting, demand side management (DSM) systems, and smart metering. Both DSM and the smart metering requirements are relevant to smart metering.

In terms of DSM, the regulation calls for the licensee to be able to remotely control all electric geysers (non-solar), heating systems, cooling and ventilation systems and swimming pool drives and heaters in all existing buildings. And exception for this requirement is given for all buildings where the licensee can remotely reduce or increase the supply of electricity through a smart system.

The regulation also requires that all end users or customers with a monthly consumption equalling or exceeding 1000kWh have smart meters installed and be on a time of use tariff.

7.2 Conflict

The regulation was not well accepted, and was seen to be infeasible by many municipalities. Lack of stable standards was one of the reasons that complying with this regulation was not possible.

7.3 Exceptions

The deadline for the implementation of systems described in Regulation 773 was the 1st of January 2012. This deadline was not met by a large majority of municipalities and extensions to this deadline were requested. A blanket exemption was not granted for municipalities, however it was agreed that any municipality applying for extension would be given an extension until 773 had been revised.

7.4 Future

NERSA (National Energy Regulator South Africa) has accepted that Regulation 773 was vague and has provided exemptions to municipalities, but officially the DOE still stands behind the regulation, but is willing to accept comment from industry to help improve it. The DOE plans to provide a framework within which to implement the goals of Regulation 773. As such, municipalities are currently not strictly required to move towards smart metering, but it is clear that the intention to move towards smart metering is there.

8. CURRENT PENETRATION IN WESTERN CAPE

Municipalities on the whole have not yet adopted smart metering on a large scale. It is not uncommon for a municipality to have a few large industrial customers being billed on a time-of-use tariff through a smart metering system, but residential smart metering is very uncommon.

Smart metering currently exists almost exclusively on the higher end users of a municipality. The municipalities rightly have started their smart metering and time of use billing on with the customers that earn them the most money, and thus the places where they can get the greatest impact per meter installed.

Currently residential implementations are few and far between, with the only real driver for residential smart metering at the moment coming from regulation 773, but due to the lack of standards and exemptions granted few municipalities have made a push to achieve the goals set out.

9. LOCAL BARRIERS

9.1 Current Standards

Currently there are no defined national standards for smart metering, and as such, municipalities are unsure of the direction to take when moving towards smart grids. Due to limited budget, municipalities are hesitant to invest capital in a system that is not based on a stable standards platform.

Concern has been expressed over the interoperability and interchangeability of smart meters. Without stable standards there is no guarantee that the meters installed now will be compatible with future meters.

While standards are currently being worked on in the NRS049 working groups, there is not yet a standard that municipalities and industry are comfortable adopting.

Split meters

Split meters are typically used in areas where meter tampering and theft threats are high. There is also a large standards issue with split smart meters that share a kiosk and communications module. Sharing a communications module can save money as multiple meters can use the same module, however there without stable standards it is unlikely that meters from different manufacturers will be able to exist together in a kiosk. This means that when a meter is replaced, if a new supplier is used, the whole kiosk must be replaced.

9.2 Cost

The relatively high cost of smart meters when compared to pre-paid meters makes the business case for smart metering fairly poor in many circumstances. Municipalities either do not have the capital available to install meters at the current price, or feel they have better uses for the capital (such as electrification.)

Individual meters can range in price from around R1 500 to R8 500 per meter to install, compared to prepaid meters which are available for under R1 000. Smart meters also require communication units which come with an additional cost which can be up to R2 000 per meter. Smart metering also requires some form of backend system to manage the meters, which is yet another expense for smart metering.

Part of the cause for this high cost is the result of a lack of national standards, with each municipality having different specifications for meters. A stable standards environment would likely decrease the cost of meters, as manufactures can benefit from economy of scale.

9.3 Management

Availability of Staff

Municipalities have concerns over available staff for running smart metering systems. Some municipalities do not have dedicated metering departments and there are concerns among those that do about the capacity of the staff to run the system.

Infrastructure upgrades

Infrastructure upgrades are also required for the implementation. Improved billing systems, meter data management systems, and upgrades to financial systems also need to be considered. Integration with finance systems that are not designed for smart metering could cause issues in setting up a smart metering system.

Reallocation of meter reading staff

Meter readers are not required in a smart metering system and current meter reading staff is not qualified for running a smart metering system. This staffs either need to be trained to be able to work in the new environment, or reallocated to a new area. The reallocation of meter reading staff may also call for additional training.

10. LIKELY IMPLEMENTATION

Smart meter rollouts are likely to be restricted to high end users at first; customers using above 1000kWh of electricity per month will be the first targets for municipalities moving forward. As prices of communication hardware and smart meters drop, they will become more appealing to municipalities and uptake will likely increase. It is unlikely that smart meters will be adopted in the immediate future for lower end users, as the amount of money earned from these customers does not justify the current cost of the meters. Once national standards are in place, prices of meters are likely to drop, and the implementation rate of smart meters should increase rapidly, especially in the case of high end users.

Full scale residential rollouts would require drastic reductions in price, with the cost of smart meters needing to be comparable to pre-paid meters for them to be worth installing on the lower end customers. Split smart meters would also require standards to be implemented.

11. CONCLUSIONS

Smart metering is a maturing technology, and as it continues to mature its benefits will improve and it will become a more attractive technology. Smart meters offer multiple benefits to utilities and provide a possible long term solution to many of the power related problems utilities face.

There are many concerns over smart meters that still exist, and not all of them will be addressed through the evolution of the technology. Many of the concerns are based on fear and lack of knowledge of a new technology.

The public perception of smart meters is a key factor that could well determine the future of smart meters. If smart meters are not accepted by the public their implementation will be slow and their benefits will be reduced.

Locally the lack of standards and high costs of smart meters makes them currently an unattractive option for municipalities for all but their highest end customers. The realisation of the significant benefits to be gained from smart meters is currently being hampered by this, but once standards are in place and meter prices drop it is likely that smart meters will be more widely adopted.

Despite these concerns smart meters form an integral part of a smart grid, and are being widely deployed around the world and are likely to improve as the technology continues maturing.

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