23rd World Gas Conference, Amsterdam 2006

THINK SMART!
THE INTRODUCTION OF SMART GAS METERS

Henk van Bruchem

Netherlands

ABSTRACT

The application of smart metering has many advantages, especially in a liberalized market. The advantages include no more meter readings at home, reduction of back office staff (caused by reduction of complaints and payment arrears), bills based on actual consumption, resulting in a better image for the energy company.
At a higher level there are additional advantages. By introducing differential tariffs, demand side management can be applied. This can lead to reduction of production capacity, energy saving (and consequently CO_2 reduction), a better security of supply and better energy crisis management. In addition, smart metering can have a large impact on energy market efficiency.
Despite its advantages, in most countries smart metering is not yet applied on a large scale. The reason for this is that the benefits are split between different stakeholders. The most logical party to invest in smart metering is the energy company (or the network operator or the measuring company, depending on the organisation of the market), but most of the benefits go to the consumer.
A better driving force for the introduction of smart meters can be created by regulation. The impending European Energy Services Directive will stimulate the introduction of smart metering by requiring regular energy bills based on actual consumption. The introduction of smart metering can be further promoted by national regulation, e.g. by allowing energy companies to increase the standing charge for the connections.
In the absence of specific regulation for smart metering, in a liberalized energy market the pressure of competition can also be used as a driving force. In this case energy companies with better, clearer bills, and better advice on energy (and cost) saving will win more customers.
Smart metering also has disadvantages. It will lead to more automation, so there will be privacy concerns and there is a potential for misuse of systems and/or data by terrorists, criminals, vandals and hackers. These concerns can and must be solved by good security.
The advantages of smart metering far outweigh the disadvantages; it is only a matter of putting the right incentives in place to provide a driving force for its large scale introduction.
Conclusion: smart meters are practically indispensable in a modern liberalized energy market, which aims to save energy and CO_2 production. With impending regulation I believe we are on the verge of a breakthrough for the application of smart meters in Europe.

TABLE OF CONTENTS

Abstract
1. Introduction
2. Advantages of smart metering
3. Demand side management
4. Energy saving/environment
5. Energy market
6. Business cases
7. Disadvantages of smart metering
8. Technology
9. Introduction of smart meters
10. Conclusions
11. References

Paper

1. INTRODUCTION

The application of smart metering[1] has so many advantages, especially in a liberalized market, that it is hard to understand why it is not yet applied on a large scale. The reason for this is probably that, although the benefits are diverse, they are split over several different stakeholders. There is a large benefit for customers, but customers are not the best party to take the initiative for the introduction of smart metering. More logical parties to take the initiative are energy companies, network operators, measuring companies or retailers, depending on how the energy market has been organized. This can vary by country. But for these companies the direct benefits do not always outweigh the costs. The solution is simple: spread the costs and benefits in such a way that everybody profits. This can be done e.g. by charging part of the cost of installing smart meters to the customers. This will induce the customers to realize one of the benefits: energy savings.
There are two basic methods to introduce smart metering:
The first is voluntary introduction, in which customers can choose whether or not to opt for a smart meter. In this case the initiative is left to energy companies, network operators, measuring companies or retailers. This method can only succeed if all stakeholders involved are made aware of the benefits. Even then penetration will not reach 100%.
The second is an introduction induced by regulation. In this case 100% penetration can be achieved, which has more advantages than partial penetration.
Both methods are viable, depending on which aims are set. A combination of methods is of course also possible.
This paper aims to outline the benefits of smart metering and give some thought to introduction scenarios.

2. ADVANTAGES OF SMART METERING

The most obvious advantage of smart metering is that manual meter reading is not necessary anymore. This reduces the inconvenience to customers and gives a financial benefit to the company responsible for meter reading (energy company, network operator or measuring company). This financial benefit does not usually outweigh the cost of installing smart meters.
However, the application of smart metering also makes it possible to improve the automation of the billing process. This reduces costs and reduces mistakes which in turn reduces costs.
Because of the automation of the billing process, payment arrears can be better managed, resulting in fewer payment arrears, a more customer friendly disconnection policy, and a better image for the energy company.
Smart metering also makes it possible to improve billing. Graphical representation of energy consumption over the past period compared with a reference consumption can provide clarity and stimulation for energy savings. Together with the reduction of complaints this increases customer satisfaction and customer bonding.
For some companies an important benefit is that it is easier to detect illegal connections (if the penetration degree of smart metering is 100%), although this is easier and more relevant for electricity than for gas.
Another advantage of smart metering is that it is easier to switch supplier in a liberalized market. This increases competition between retailers, resulting in lower prices. These are just a few fairly obvious advantages. But there are more advantages at a higher level.

[1] In this paper ‘smart metering’ is defined as metering with added functions apart from measurement itself. So automatic meter reading (AMR) is within this definition.

3. **DEMAND SIDE MANAGEMENT**

The application of smart metering opens up the possibility of applying differential tariffs. Differential tariffs in turn open up the possibility of demand side management. Shortage of energy leads to increasing prices, leading to decreased consumption. In this way less production capacity is required, which can result in large savings, especially for production of electricity. This has a large political impact, and can influence national energy policies, it might e.g. give more time to develop and apply sustainable energy. For gas, it is questionable if differential tariffs can influence consumption. However, if smart gas metering can achieve peak shaving, this might require less transport capacity and/or less storage capacity. Reduction in storage facility alone could make it worthwhile to apply smart metering in a large area.

A Precondition for this form of demand side management to work is that customers can easily see the price of the energy and react to it. This is only possible with smart metering.

Smart metering can also play an important role in energy crises. By disconnecting or reducing the energy supply (this last only for electricity) to some customers the loss of supply for other customers can be avoided.

So smart metering can play an important role in security of supply, in crisis control and even in national energy policies.

4. **ENERGY SAVING/ENVIRONMENT**

The application of smart metering has a large potential for energy saving. The amount of energy that can be saved will depend on several factors; current estimates in the Netherlands range from 2-5%. Energy saving is promoted by impending European legislation. The EU is preparing an Energy Services Directive, from which the following quote speaks for itself:

Article 13

Metering and informative billing of energy consumption

1. Member States shall ensure that:

final customers or end users of electricity, gas, district heating and/or cooling are provided with competitively priced individual meters that accurately reflect the customer's or user's actual energy consumption and that provide information on actual time of use, in so far as this is technically possible, financially reasonable and proportionate in relation to the potential savings.

2. Member States shall ensure that:

where appropriate, billing performed by energy distributors and retail energy sales companies is based on actual consumption, presented in clear and understandable terms and is carried out frequently enough to enable customers to regulate their own energy consumption. Information on distribution charges, energy volume charges and other associated charges shall be made available with their bill to provide the consumer with a comprehensive account of current energy costs.

3. Member States shall ensure that:

where appropriate, the following information is made available to final customers in clear and understandable terms by energy distributors or retail energy sales companies in or with their bills, contracts, transactions, and/or receipts at distribution stations:

(a) current actual prices and actual consumption;

(b) comparisons of the consumer's current energy consumption with consumption for the same period in the previous year, in preferably graphical form;

(c) whenever this is possible and provides an added value, comparisons with an average normalised or benchmarked user of energy of the same category;

(d) contact information, including website addresses, where information on available energy efficiency improvement measures, as well as technical specifications for energy using equipment, may be obtained.

So a frequent direct feedback of the actual energy consumption is required. In practice this can only be achieved with smart metering. Smart metering may also open the door for new energy services, e.g. energy saving advice. A direct feedback of the actual consumption is a start, but better results can be achieved if specific advice is given, expressed in Euros, Dollars, etc.
In the Netherlands, technical means to save energy are becoming exhausted, so the only remaining way to save energy is by behavioural change. And this can best be achieved by making clear how much certain behaviour costs, and how much can be saved by other different behaviour.
Also, there is a discussion in the Netherlands about saleable energy savings certificates ('white' certificates). If these certificates are introduced, this will provide another stimulant for smart metering.
There is also a relation with another EU directive, the Energy Performance in Buildings Directive.
Finally, it is evident that saving energy will also result in reduction of CO_2 production.

5. ENERGY MARKET

Smart metering may also play a role in simplification and efficiency of the energy market. This varies per country, of course, since this depends on how the market is organised in different countries. In the Netherlands there is a free market for measuring companies. This means that customers can choose which company reads their meters. This causes a lot of extra administration due to switches of measuring company. For this reason EnergieNed, the branch organisation of the Dutch energy companies, advocates a regulated meter market instead of a free market. It is estimated that this will result in a saving of 25.10^6 Euro per year.
As mentioned earlier, another advantage of smart metering is that it is easier to switch supplier in a liberalized market. This increases competition between retailers, resulting in lower prices.
Another advantage is that if billing is based on actual consumption, reconciliation[2] will not be necessary anymore. In theory this sounds advantageous, but for gas in practice this will mean high bills in winter and small bills in summer. For certain customers it will be more attractive, however, to pay fixed amounts per period. But at least it might be possible to abandon reconciliation due to the application of consumption profiles.

6. BUSINESS CASES

In the Netherlands various business cases have been made. The most comprehensive one comprised 25 cost/benefit factors for electricity and gas and was made by Kema for the Ministry of Economic Affairs (1,2). In this business case the procurement and installation of meters and data communication (depending on the chosen technology) were identified as major cost factors. Reduction of complaints (reduction of call centres), energy saving and reduction of energy price due to increased competition because of an easier switching process were identified as major financial benefits. The conclusion was that overall the business case yielded a positive result, but the benefits were not equally divided between the stakeholders involved. For the consumer a high benefit was calculated, but for measuring companies, regional and national grid operators, suppliers, producers and government the business case had a negative outcome. Therefore it was proposed to increase the standing charge by 11-12 Euro per year. Related to the average standing charge this means an increase of 25%. Related to the average household energy consumption this means an increase of about 1% per year.
The outcome of business cases depends on the assumptions made and the cost/benefit factors which are evaluated. In the business case made by Kema, the depreciation of the existing conventional meters was not taken into account. Neither was the benefit of decreased production.

[2] Reconciliation = settling of differences between estimated consumption and actual consumption, either due to the application of consumption profiles and/or the application of fixed bills.

The outcome of business cases also depends on weighing up of cost/benefit factors. This explains why some initiatives for smart metering were taken in the Netherlands by network operators or measuring companies, despite the fact that the business case for these parties separately was negative in the Kema study.
Kiwa made a business case for the introduction of smart water meters (5). This business case also had a positive result, but pay back times of 12-15 years were calculated, depending on the chosen scenario. This is too long to be attractive. If the business case is based on multi utility application of smart metering, the pay back time for the water companies is shortened to 3-10 years.
So far, published business cases for energy companies have not taken the additional benefit of smart water metering into account.

7. DISADVANTAGES OF SMART METERING

In the discussion about all the advantages of smart metering, the disadvantages should not be forgotten. Smart metering leads to more automation, so there are privacy concerns and there is a potential for misuse of systems and/or data by terrorists, criminals, vandals and hackers.
These concerns can and must be solved by good security.
Another concern is the development rate of (standards for) communication technology. This makes it hard for a manufacturer to commit to one technology. For this reason a standardization process was started in the Netherlands (3). This standardization must ensure that the chosen communication technology (including communication protocols) will last at least as long as the lifetime of the meters. It must also ensure the exchangeability of meters.
A last concern is that careless introduction of smart metering and related possibilities (e.g. differential tariffs) may lead to decreased customer satisfaction.
But all in all it seems that these disadvantages can be overcome and will not outweigh the advantages.

8. TECHNOLOGY

Although this paper is not meant to go into technical details, it is important to look at some trends in available technology for gas meters and for data communication.
For gas meters, smart metering is often associated with electronic meters which is are more or less equivalent to ultrasonic meters. In a recent survey by Kiwa Gastec, however, it was found that ultrasonic meters have not found a large application since they were introduced to the market and the number of manufacturers seems to have decreased (6). It was also found that in smart metering projects, mostly conventional gas meters with automatic meter reading facilities were used. The reason for this is probably that ultrasonic gas meters are more expensive than conventional gas meters.
For any smart metering project the choice of the data communication system is crucial. There are many communication systems, but the most viable ones seem to be Power Line Communication (PLC), Internet and GMS/GPRS.
In the PLC technique, the local electricity distribution grid is used to transport communication signals. The data is transported to a data concentrator and from there by glass fibre connections (or GMS/GPRS) to central data centres. For application of smart electricity meters or combined smart gas, water and electricity meters, this is a relatively low cost communication system.
Internet is also a relatively low cost communication system, and again communication of the gas and water meter takes place via the electricity meter. For this communication system a permanent internet connection is required. Currently about half of all Dutch households have such a connection.
GMS/GPRS is a more expensive data communication system (with a corresponding negative effect on business cases), but it can be used in situations where PLC or internet communication is

not possible.

9. INTRODUCTION OF SMART METERS

There are different scenarios for the introduction of smart meters. As already mentioned, two basic methods are voluntary introduction with a less than 100% penetration and a regulation induced introduction with which a 100% penetration can be achieved.
Depending on the situation, both methods can have positive business outcomes. For some benefits 100% penetration is required.
Voluntary introduction is best aimed at specific target groups. These might be customers who are interested in energy saving, customers with payment problems, or those with complaints. For voluntary introduction to succeed a lot of effort must be put into convincing the stakeholders involved of the benefits.

10. CONCLUSIONS

Smart metering can have a large impact on energy saving, CO_2 production, national energy policy, security of supply, organisation and efficiency of the energy market and customer benefits.
It seems that with given the impact on these subjects, combined with impending EU and national regulation it will only be a matter of time before smart metering is applied on a large scale.
The combined introduction of smart electricity, gas and water meters achieves the best benefits. Smart gas or water metering cannot be seen separately from smart electricity metering. In smart metering electricity takes the lead and it is only smart to connect gas and water meters to the same communication system.

11. REFERENCES

1. R.J.F van Gerwen et al, Kema (2005), Domme meters worden slim? Kosten-batenanalyse slimme meetinfrastructuur
2. A. Dijkstra et al, SenterNovem (2005), Advies invoering slimme meetinfrastructuur bij kleinverbruikers
3. O. Costenoble et al, NEN (2005), Strategische verkenning meetinfrastructuur en slimme meters voor energieverbruik
4. Proposal for a Directive of the European Parliament and of the Council on energy end-use efficiency and energy services (Energy Services Directive), (2005)
5. Kiwa workshop for smart water metering (2005)
6 H. van Bruchem et al, Kiwa Gastec Technology (2005), Alles over gasmeters. (Confidential report)