Annual Report on the Progress in Smart Metering

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About the European Smart Metering Alliance (ESMA)

This Report is produced by the Project Team of the European Smart Metering Alliance (ESMA). ESMA is an alliance of companies and organisations for the advancement of smart metering in Europe. ESMA is working to develop best practice in smart metering so as to deliver the best energy saving benefits. It has been formed by a number of interested organisations from across Europe - from academics to utilities and energy agencies - with partial funding from the European Union's Intelligent Energy for Europe programme.

ESMA consists of a Project Team and an Alliance. The ESMA Project Team is responsible for producing a number of European-wide reports on smart metering, including this Guide. The Alliance works together closely with the ESMA Project Team and some members have provided material for this Report.

Membership of the alliance is open to all organisations involved in smart metering at a nominal fee of € 500 per annum[1]. Members of the Alliance have the benefits of being informed of smart metering developments throughout Europe; being able to play an active part in shaping the activities of the Alliance; and having access to all of the project deliverables. More information about the European Smart Metering Alliance is on the website: http://www.esma-home.eu

[1] Non-corporate organisations can join the Alliance for free. Please contact esma@beama.org.uk for details.

1. Executive summary

This is the first Annual Report published by ESMA. It follows the publication of a series of reports that have investigated and set out the current situation of smart metering and best practice related to achieving energy savings and sustainability through smart metering. The intention is that the Annual Report will update these reports and, over time, provide a rolling commentary on the implementation of smart metering across Europe and how it has supported energy savings and other social goods.

The report examines four key items:

- Progress in implementing smart metering across Europe. The report provides a number of statements on the progress in countries across Europe. These cover most of the circumstances found in European Member States, ranging from near implementation to little or no progress. The report also contains in-depth studies of Norway, the Netherlands, Germany and Ireland. These were chosen as they illustrated important developments. Future versions of the Annual Report will contain in-depth reports on other countries.

  As well as the descriptions of progress in countries, the report also contains a listing of the smart metering roll outs across Europe. This shows that there are a large number of individual projects underway or announced. Mostly these are trials or pilot projects, although in Italy, Sweden and Finland, smart metering is being fully implemented. However, the more recent projects, driven by the Energy Services Directive, have a greater focus on energy savings and, in many cases, the trials are assessing the impact of smart metering on customer behaviour. One key observation from this review is that the largest numbers of smart metering installations are happening in the US, not Europe.

- A number of European countries and large DSOs have made announcements regarding full implementation of smart metering, committing themselves to roll outs by a certain year. These include Norway, Spain, EDF in France, UK, NL, Portugal and Ireland.

- Development of smart meters and related technology, with a primary focus on those related to customer feedback and energy control. In this area a large number of feedback devices, both hardware and software based, have been identified, primarily being developed in Europe and the US. A significant development is the emergence of devices designed to connect to wired and wireless open home area networks. This opens up the possibility of linking smart metering to smart homes and the creation of large markets for standard devices.

A further development that is apparent is a large number of alliances within the metering industry. These appear to be aimed at proving end to end capability or extending the range of products that can be connected to proprietary networks. These developments follow from the current lack of open standards covering all elements of smart metering systems. A further response to this issue has been the publication of a mandate by the European Commission to the European Standards Organisation (CEN/CENELEC/ETSI) to develop the necessary standards to support an open market for smart metering components in Europe.

- Updating the evidence on the energy savings benefits of smart metering. ESMA produced a report[i] that reviewed the current evidence for energy savings and other environmental benefits arising from smart metering. The intention is that this evidence will be updated in each Annual Report as trial results are published. In actual fact, there have been no results published since the preparation of the previous report and the end date of the current report. Thus it has not been possible to move beyond the conclusions of the previous report. However, as has been mentioned, there are a large number of trials underway and it is anticipated that results will be available from these in time for the next Annual Report.
- A review of barriers affecting smart metering. These are summarised below:
  - There is still much uncertainty about the quantification of benefits as practical experience and historical data are lacking.
  - There are many parties involved, and the benefits of smart metering may accrue to other parties than the ones that bear the costs.
  - In a big scale, roll out of smart metering is a very long and costly process, requiring considerable capital expenditures from the responsible market actors while in many EU countries, there is a big opposition from regulators to increase the tariffs to final users to pay for it.
  - There is no interoperability between different owner's assets: no open registered standard exists which properly scopes the different functions (metering, communications, presentation, and network). The lack of adequate common requirements on functionality and open interfaces (interoperability) fractionalizes the market and increases costs both for smart metering and for the applications and services that use metered data.
  - There is also a lack of modularity and lack of flexibility of present mass smart metering so special needs regarding distributed generation, demand response,

power quality, customer information, energy efficiency automation and services can only be met with high extra costs.

2. Introduction

The European Smart Metering Alliance (ESMA) is a European project that was initiated under the Intelligent Energy Europe (IEE) program. In the ESMA project the metering industry and research organisations are cooperating to exchange best practices in the field of Smart Metering in Europe. The general objective of ESMA is to increase the energy saving benefits of Smart Metering and to identify and spread best practices in smart metering across European member states. In this context ESMA supports Article 13 of the Energy End-Use Efficiency and ESCO Directive[ii]. The ESMA project is aimed at producing a series of reports on key aspects of smart metering and especially the European Smart Metering Guide, the first edition of which was produced in 2008.

The present Annual Report on the Progress in Smart Metering – edition 2008 is an important complementary element presenting a review of the situation across EU Member States and Norway, also against the background of chosen regions and countries through the World.

This report constitutes Deliverable 17 of the European Smart Metering Alliance (ESMA) project (http://www.esma-home.eu). The report reviews the progress in the field of development and implementation of smart metering that has been achieved by European Union Member States and for comparison by other chosen regions and countries through the World in the year 2008.

3. Scope and methodology of the report

The Annual Report reviews the development of smart metering and tries to identify progress in smart metering implementation in Europe and particularly in chosen countries highlighting different approaches to questions related to regulations, law and technical solutions.

“Deep stories” show in detail the current situation with regard to smart metering implementation in Germany, The Netherlands, Ireland and Norway. Attached information covers the current status of the process as well as many other aspects influencing this process starting from historical and social aspects, going through problems related to cost/benefit analyses, legislation, promotion and cooperation between market actors. This information is presented in order to help and support decision makers and stakeholders from countries starting such implementation processes.

A complete list of benefits attributed to smart metering systems, either those under development or fully operating, is also presented. This part of the report is primarily aimed at updating the evidence for or against energy savings arising from smart metering but it also addresses other important benefits, such as improvement in customer service quality, quality of grid operation or demand side management..

Chapter 7 presents information on recent developments in smart metering technology in order to inform all necessary parties of the key features and new possibilities connected with smart meter techniques.

Chapter 8 is dedicated to identification and analysis of the main barriers preventing the spread of smart metering in EU and outside Europe. Special attention is dedicated to legal, economic and technical barriers. Barriers related to awareness raising and customer reaction are also considered.

4. Basic definitions and terms

This report focuses on the promotion of Energy Saving of Energy Customers in relation to Smart Metering. In the utility world several definitions of Smart Metering are used, depending on which of the possible services are included or not. Within the context of this report the following definition of 'smart metering' is used. Smart metering has the following features:

- Automatic processing, transfer, management and utilisation of metering data
- Automatic management of meters
- Two-way data communication with meters
- Provides meaningful and timely consumption information to the relevant parties and their systems, including the energy consumer
- Supports services that improve the energy efficiency of the energy consumption and the energy system (generation, transmission, distribution and especially end-use)

The report is also primarily concerned with developments in Europe. However, depending on the circumstances, the scope has been extended where it was felt that it was necessary to tell the full story. For instance, the extent of the roll out of smart metering in the US is highly relevant to developments in Europe, as it could affect the opportunities to develop business in Europe, and might influence the development of standards.

5. Review of smart metering development in Europe

This Chapter includes a review of progress in smart metering development in EU member states made during 2008. The introduction includes comment on some of the common features for all countries and some specific approaches and solutions that have been observed in different countries.

5.1. General review of Smart Metering Schemes in EU member states

The liberalisation of the European Energy markets will transform electric power from a utility into a commercial commodity. Energy prices will adjust to balance supply and demand at the European level, rather than through regulations at a national level. This, in combination with a general consensus that long-term sustainable development will require massive investments in generation of electricity from renewable energy sources and the risks of higher marginal production costs for electricity and possible also shortages on the supply-side due to lack of generation of generation capacity, feeds the growing importance of energy savings in Europe. This is leading to a growing interest in smart metering as one means of delivering these savings.

The adoption of smart metering in Europe is to a large extent governed and driven by regulations because of its relevance to the general public. Electricity reaches virtually every household and business in the whole of Europe while gas is widely used in The Netherlands, UK, Italy, Germany, France and Poland and district heating is a significant source in the Nordic countries and Central Eastern Europe. National concerns over the future energy situation and European initiatives such as the EU-ESD have led up to mandatory requirements or proposals for them for the deployment of smart meters in several countries. By the end of 2008, final dates for when smart metering should be in place had been set in:

- France;
- Ireland
- Italy
- The Netherlands
- Sweden
- Norway
- Spain
- UK

Except for Italy (where the legislation is primarily aimed at extending coverage for the final remaining part of the electricity customers) the large countries have a long-term perspective with deadlines in the second half of the 2010s. A notable exception is Germany that has so far rejected proposals for mandatory rollouts, even though the issue is still open for discussion.

Deployments of smart meters for residential electricity customers are currently underway in eleven European countries:

1. Italy: was the first to adopt the technology in the first half of this decade. By 2011, all 36 million electricity customers will be covered by smart metering;
2. Sweden: will be the first one to achieve a 100% penetration in July 2009 when monthly collection of meter data becomes mandatory.
3. Denmark: main electricity DSO's are deploying smart meters;
4. Finland: In December 2008 the final hearing of new legislation that requires nearly full penetration of hourly metering and settlement by 1 January 2014 was completed.
5. Norway: due to follow in 2010 when meter regulations will be finalized;
6. France: ERDF, the French electric network of EDF, announced the first phase of a nationwide rollout of 33 million smart meters in July 2008;
7. Spain: Endesa and Iberdrola each plan to deploy 10 million smart meters each in order to comply with new regulations in Spain;
8. Ireland: nationwide program for deployment of smart meters by 2013;
9. The Netherlands: July 2008: Dutch parliament adopted revised legislation on smart metering; introducing a two-year trial-period to ensure a relaxing mandated rollout (needs to be confirmed in Senate in April 2009). In the meantime, Dutch fourth largest energy supplier Oxxio has installed over 100.000 smart meters in the residential sector already.
10. UK: 30th of October 2008: Government decides for a national roll out of duel fuel smart metering for all 27 million households before 2021, introducing a two-year trial period to determine the details of the mandated rollout;
11. Germany: 19th of February 2008: German utility RWE announced that it will install 100.000 smart electricity meters in Germany, making this the first project of its kind in the country. However, legislators in Germany have so far rejected proposals for mandatory rollouts, even though the issue is still open for discussion.

Elsewhere in Western Europe, the markets are developing more slowly.

In Appendix 2 there are presented initiatives, pilot projects and trial initiatives related to development and implementation of smart metering technology through the European countries as well as Canada and USA. This list relates to those projects that are currently active, it excludes those that are complete and those that are proposed but not in the implementation phase. The rest of World is represented by Australia, New Zealand and few other countries.

The data presented shows that, based on current activity, the large majority of smart meters being installed are in the USA and Canada.

5.2. Country information

In this section an update on countries around Europe is provided. The information on each country consists of one paragraph on current status of smart metering implementation development and a summary table. The current achievements/status in each country are presented against a background of other related developments and specific supporting activities.

5.2.1 Great Britain

Official country implementation plan	In the UK the Government announced that it will mandate smart metering for the residential sector, On the 28th October 2008 the Government stated that "…., I am pleased to announce that the Government have taken the decision to mandate smart meters for all households...." The existing powers in the Energy Bill will enable the Government to proceed with a domestic roll-out. The Government is now consulting on the precise details of the mandate that it will issue. In addition the Government has required that from 1st April 2009, energy suppliers should provide advanced metering for the commercial market whenever a meter is replaced and that all customers should be provided with an advanced meter by 2014.
Law regulations related smart metering implementation – obligations, deadlines/goals	At yet no regulations have been published. The expectation of the government is that full roll out will be complete by 2020.
Availability of smart meter technology	Smart meter technology is available from vendors, however, meter vendors are awaiting a final meter specification from the energy companies before producing meters and systems specifically tailored to a UK roll out.
Economic profitability	The UK Government published a consultation on 10th December 2008 reviewing the level of meter functionality to be included in their mandate. This included figures for the cost benefit of various levels of functionality for electricity and gas smart metering.
Pilot projects and initiatives	There are four major trials of smart metering being sponsored

	by the UK government. The most recent report from this trial can be found on the OFGEM web site[iii]. These began in 2007 and are being conducted by EDF Energy Customers plc, E.ON UK plc, SSE Energy Supply Limited and Scottish Power Energy Retail Limited. The trials are due to conclude in 2010.
Research and development activities	In the UK a key research activity has been the development of meters that can identify specific loads from the total import measure at the supply meter. The Coracle device has been developed by Sentec[iv].
Number of existing smart metering schemes (in operation)	In the UK all half hourly read electricity meters must be read remotely, according to Elexon Code of Practice 5.
Key features of the schemes	Code of Practice 5 meters meet all of the functional requirements currently being considered for the UK residential market mandate. They can be remotely read, managed and will provide interval and power quality data.
Number of smart metering systems available	The CoP 5 sector currently comprises approximately 110,000 meters.
Number of smart metering meters and provisions of progress in increase of smart meter number	The commercial market will be switching to advanced metering from April 2009 but, within the report timeframe, there has been no increase in smart metering.

5.2.2 Czech Republic

In the Czech Republic, two main pilot projects testing the AMM technology have been carried out recently. The former one was implemented by CEZ, the former monopolist electricity producer and now the leading integrated nation-wide electricity producer, distributor as well as supplier, in East Bohemia (at ca 2 000 supply points) and the latter by E.ON in four selected municipalities in South Moravia (ca 4 000 supply points). In both cases the primarily purpose of their realization was to assess the feasibility and reliability of various AMI/AMM technologies and, so far, have not included the provision of enhanced information on energy use towards end-users. The first results and experience from both pilots (after nearly one year of real operation more less by each) was presented in autumn 2008 at the conference named “Smart metering” organized by IIR in October in Prague. Representatives from both companies mostly reported on miscellaneous technical problems and bottlenecks which the implementing teams had encountered so far and how these were solved. For each pilot, several technologies for metering of electricity (and for the CEZ pilot, also of gas) consumption and consequent data transfer have been tested. The main subject of the testing was continuous metering of load profile (energy use), remote disconnection of a meter, and use of ripple control (for heating appliances).

Based on the results of both pilots, decision will be made how on how to continue further. As a natural next step (by SEVEn) to complement the existing pilots the effect on the energy consumption behavior of final customers as a result of providing feedback information will be tested.

Official country implementation plan	In the Czech Republic there is no official implementation plan for smart metering, yet.
Law regulations related smart metering implementation – obligations, deadlines/goals	There are no obligations yet.
Availability of smart metering technology	It has not been decided yet.
Economic profitability	The economic profitability will be analyzed in the upcoming complex pilot scheme to be conducted by SEVEn.
Pilot projects and initiatives	Two pilot technical assessment projects with two utilities have been carried out.
Research and development activities	A new, complex pilot scheme to make us of effective instruments is now under preparation. The pilot scheme will feature a technological solution, information tools as well as financial incentives to be available to end-users.
Number of existing smart metering schemes (in operation)	None yet, but a test scheme currently under preparation (also under discussion with the Energy Regulatory Office)

Key features of the schemes	There are three main components of the scheme: 1) **Technological solution** will be either based on the existing pilot project (AMM), or to some extent independent. There are several functions which are to be included whichever solution is finally chosen. The smart metering infrastructure should provide detailed information on energy consumption – total as well as from different loads, energy costs, etc. A system fulfilling the above requirements developed by Czech company KMB systems has been installed at the SEVEn premises and is being tested. The information is then likely to be provided to the end-user through telecommunications network such as GPRS/CDMA/UMTS and other. 2) **Information tools** are a supporting instrument, which should provide the end-user with additional information and advice. It is planned that based on the metered data, the end-user will be able to make his/her own "energy audit" of the household and evaluate potential energy/financial savings. If needed, the information tool will also allow users to carry out control measurements and provide consultancy and advice (suppliers, customer centers, consulting companies, etc.). 3) Nevertheless, it is clear that the activity will have to be supported by **financial incentives** to the end-users. These incentives will have a form of either **discount on energy efficient appliances** or a **creation of special tariff rate, rewarding 'negawatthours'** generation (as to environmental benefits up to **0.04 EUR/kWh** compared to referential consumption). Another solution is then to introduce a special premium on end-users electricity consumption (e.g. 0.004 EUR ~ 5 mil. EUR/year), or to use revenues from saved CO_2 allowances sale (at cost 5-15 EUR/ton of CO_2, ~ 0,005 – 0,02 EUR/kWh of saved electricity)
Number of smart metering systems available	No data available
Number of smart meters and provisions of progress in increase of smart meter number	Presently several thousand AMM type meters installed countrywide in two field trials by two major electricity suppliers, E.ON and CEZ another of similar size (2 thousand. metering points) shall be introduced in 2009/2010 by other electricity supplier – PRE. Under discussion is to extend one of the trials onto 40 thousand households.

5.2.3 Finland

Official country implementation plan	Nearly full electricity smart metering penetration by 1 January 2014. There is no official country plan for district heat meters or for water meters.
Law regulations related smart metering implementation – obligations, deadlines/goals	DSOs are responsible for metering. The electricity DSOs have a natural distribution monopoly and must be unbundled from competitive operations such as electricity retail and generation. New legislation (66/2009 Valtioneuvoston asetus sähköntoimitusten selvityksestä ja mittauksesta) came into effect 1 March 2009 and requires the following. - 2011 all over 3x63A connection points must have remotely readable hourly metering - 2014 full smart metering penetration with minor exceptions - there are some minimum functional requirements such as: hourly interval measurement data available next day to market actors including the customer, at least one control signal to customer via the metering system, registering over 3 min outages and two way data communication with data security. (Remotely readable meters already installed are allowed exceptions regarding the minimum functional requirements) - starting 1 January 2012 settlement by hourly metered data is required for all customers that have meters capable to hourly metering.
Availability of smart metering technology	It is a common view that technology is available.
Economic profitability	Economic profitability is inadequately detailed, analysed and discussed publicly.
Pilot projects and initiatives	Full nationwide implementation of smart metering is on the way. Some pilot projects related to smart metering for distribution automation are going on.
Research and development activities	There are some ongoing national projects such as INCA and ENETE. The focus of the former is in integrating customers to future smart grids and energy markets. The focus on the latter is on energy efficiency and demand response. In addition there are R&D activities related to using smart metering data in energy analysis.
Number of existing smart metering schemes (in operation)	Many. (More than 10)
Key features of the schemes	Most remotely readable meters are capable to hourly metering.

Number of smart metering systems available	All smart metering systems that meet the above mentioned minimum requirements and the own requirements of the DSO. There are about 10 providers of smart metering services for the DSOs.
Number of smart meters and provisions of progress in increase of smart meter number	About 1 million remotely readable electricity meters in operation in 2009. The total number of meters is about 3.1 million. Over 80 % penetration in each DSO is required by national legislation by 1 January 2014. About 50% of district heat meters are in remote reading and many meters are such that can be connected to remote reading. Except for some piloting, the utilities have not yet applied large scale smart metering of water consumption. Multi utility metering is sometimes used but not systematically in all cases where it would be technically beneficial.

5.2.4 Latvia

In Latvia the implementation of AMR systems carried out by the main DSO AS Sadales tīkls is based on 4 stages of development:

- 1st stage – 13 substations with cross border meters and 5 power plants (July, 2004);
- 2nd stage – all other substations (September, 2005);
- 3rd stage –regional borders of distribution network and two apartment houses in Riga (April, 2007);
- 4th stage – middle voltage customers and distributed power plants, etc (in progress).

In particular the current status AS Sadales tīkls AMR system includes the installation of 1437 meters for distribution network. In particular:

- 1 168 meters in 110kV substations;
- 49 meters on distribution network region borders;
- 28 meters in cogeneration power plants;
- 17 meters for industrial large consumers;
- 175 household consumer meters in 2 apartment buildings in Riga

Regulations about installation of smart metering and for example about mandatory hourly metering in Latvia for all final consumers are not yet implemented.

All consumers with a permitted connected load of 100 kW and higher are connected to Automatic Meter Reading (AMR) system. Also independent producers of electricity are connected to the AMR system. On the other hand, residential customers have mainly ordinary electromechanical meters, which are being replaced step by step with electronic meters but which are not typically connected to the AMR system.

For residential consumers meter reading shall be done on the first day of each month by the customer and the payment for the consumed electricity shall be made by the end of the respective month. Residential customers have then several possibilities for the payment: payment in cash at banks and post offices, by bank transfer via Internet bank, Internet payment at utility web page and lately as well as automated average billing where the customers are charged automatically the same amount every month based on an average of their consumption over the past six months.

Official country implementation plan	In Latvia there is not an official implementation plan for smart metering
Law regulations related to smart metering	There are not obligations

implementation – obligations, deadlines/goals	
Availability of smart metering technology	Imported
Economic profitability	
Pilot projects and initiatives	In the residential sector a pilot project in two buildings
Research and development activities	Research on smart grids in Riga Technical university – Faculty of electrical and power engineering
Number of existing smart metering schemes (in operation)	1 scheme for large consumer with permitted connected load 100 kW and higher
Key features of the schemes	For objects that are connected to AMR and who are simultaneously permitted connected load is 100kW and higher – the meter data are exported to AMR system on a daily basis; after that, the data are exported from AMR system to CSPS (Customer Service and Payment System). DSO (Sadales tīkls) sends a bill for distribution system services to the user once a month; at the same time, DSO forwards the load profile data to the trader, who issues a bill for the electricity consumed.
Number of smart metering systems available	1
Number of smart meters and provisions of progress in increase of smart metering number	1 168 meters in 110kV substations; 49 meters on distribution network region borders; 28 meters in cogeneration power plants; 17 meters for industrial large consumers; 175 household consumer meters in 2 apartment buildings in Riga

5.2.5 The Netherlands

Official country implementation plan	The Netherlands Amendment of the Electricity Act 1998 and the Gas Act for the purpose of improving the operation of the electricity and gas market and Implementation Directive 2006/32/EC
Law regulations related smart metering implementation – obligations, deadlines/goals	The Netherlands Amendment of the Electricity Act 1998 and the Gas Act for the purpose of improving the operation of the electricity and gas market and Implementation Directive 2006/32/EC.
Availability of smart metering technology	Specification according to Netherlands Technical Agreement number 8130.
Economic profitability	The cost/benefit analyses of these measures are considered favourable at the level of consumers as well as at the macro level. Combined with the introduction of the supplier model (savings of € 15 million a year), introducing the capacity tariff is expected to generate a further € 30 million a year. These cost savings will also mainly be made by the grid operator. The Bill provides for cost savings made by the grid operator to directly bring about a reduction in the transmission tariffs. Cost benefits will be enjoyed by various parties (supplier, grid operator, small consumers). However, if suppliers were to roll out the smart meters, it is estimated that, for commercial reasons, only 30 to 35% of small consumers would end up having a smart meter. This is not desirable, because a number of benefits in the public interest –such as ensuring security of supply and energy efficiency – can only be achieved with a 100% rollout. So to ensure that these benefits are actually exploited, it is necessary for the rollout to be regulated.
Pilot projects and initiatives	The introduction of smart metering will take place in two phases: o a two year 'start up' phase for new houses and large scale reconstruction according to the Directive. In the meantime, functional specification is being reconsidered by network operators for more future-proof design. o an 'acceleration' phase after discussing the extra specifications and evaluating the other qualities of the present smart meters being used so far.
Research and development activities	The meters that are installed must comply with the statutory requirements. Compatibility and interoperability must be ensured so that the functions of the meter can be effectively used by various parties without any unnecessary technical ramifications. For this reason, the Bill provides for a delegation provision that allows for more detailed output-related or technical requirements on meters in local government legislation. To this end, the Nederlands Normalisatie Instituut (Dutch standards institute) in collaboration with the energy sector and the parties involved defined the functionalities of the smart meter in a National Technical Agreement (NTA 8130).
Number of existing smart metering schemes (in operation)	A number of trials are underway.
Key features of the schemes	1. Introduction of the supplier model for small consumers for billing and complaints handling; 2. Introduction of a fixed tariff for transmission costs based on the electrical capacity of the connection (capacity tariff);

	3. Introduction of smart gas and electricity meters and make the corresponding changes in the tasks and responsibilities of the parties involved in these meters; 4. Regulation the way in which information is exchanged between market parties.
Number of smart metering systems available	Only commercial energy supplier Oxxio offers residential customers to have a smart meter installed.
Number of smart metering meters and provisions of progress in increase of smart metering number	By March 2009, over 100.000 households have a smart meter, installed by Oxxio.

5.2.6 Norway

Official country implementation plan	There is not an official implementation plan yet: In a discussion document concerning the regulations for metering and settlement, mandatory implementation of Smart Metering for Final Customers in Norway is expected from 1.1.2014. http://www.nve.no/FileArchive/262/AMS.pdf
Law regulations related smart metering implementation – obligations, deadlines/goals	Metering and billing of Final Customers is regulated by the Norwegian Water and Energy Directorate (NVE). According to NVE's rules DSOs are responsible for metering and from the 1st of January 2005 all metering points with annual consumption higher than 100.000 kWh have to be hourly metered. Based on the discussion document concerning the regulations for metering and settlement, all customers should have hourly metering within 1.1.2014.
Availability of smart metering technology	In general the market is traditionally dominated by Smart Metering equipment and concepts from the Nordic Countries as Senea, Kamstrup, Enermet (Landis&Gyr), Telenor Cinclus, Aidon etc. Several advanced technologies have been tested, but cost/benefits estimations limit implementation of very advanced functions.
Economic profitability	Several cost/benefit studies have been recently conducted. The latest conclusion is that implementation of Smart Metering normally is not profitable for DSOs yet, but it is clearly beneficial for the whole society. http://www.nve.no/FileArchive/84/ECON_Ny_maalerteknologier.pdf
Pilot projects and initiatives	Smart Metering is in regular operation at big customers (annual consumption over 100.000 kWh). Smart Metering for households has had big scale tests in the last 5-6 years. Today the companies prepare for full scale implementation. There are several initiatives, related to AMR, where Nordic AMR Forum is probably the most interesting one. http://www.sintef.no/Projectweb/AMRforum/
Research and development activities	End-user flexibility by efficient use of ICT (2001-2004) and Market Based Demand Response (2005-2008) are the central projects, related to Smart Metering. http://www.energy.sintef.no/prosjekt/mabfot/UK/uk_index.asp
Number of existing smart metering schemes (in operation)	All existing DSOs have hourly metering of customers with consumption more than 100.000 kWh, while app. 10-15 DSOs have voluntarily implemented Smart Metering for all customers.
Key features of the schemes	Remote reading of the consumption is hourly or in some cases weekly (households). Possibility to view the consumption data via Internet. Normally the communication is based on Gsmart metering, PLC or combination of those depending of the landscape and settlement.
Number of smart metering systems available	There are no limits for systems allowed to be used. Any existing Smart Metering solution can be purchased and installed)
Number of smart metering meters and provisions of progress in increase of smart metering number	Based on today's regulations 4-5 % of all existing metering points in Norway have hourly metering. This represents approx. 100.000 customers and 60 % of the total electricity consumption in Norway.

5.2.7 Poland

Official country implementation plan	There is no an official implementation plan in Poland. The Feasibility Study for Implementation of AMR for electricity in housing sector in Poland was prepared by The Energy Regulatory Office and officially presented in December 2008. Smart Metering considered in this document as a mean and tool for improvement of energy efficiency in housing sector. Some raff information and analysis within dissemination and promotional activities is published by the Energy Regulatory Office. www.ure.gov.pl
Law regulations related smart metering implementation – obligations, deadlines/goals	No regulation related smart metering at place at the moment. No legislative initiatives are considered in plans for nearest future.
Availability of smart metering technology	In market there are already available products and technologies of many different manufacturers and distributors of smart metering equipment from all over the EU countries as well as from US. It concerns almost all technologies and systems including very advanced functions and data transmission systems.
Economic profitability	The Feasibility Study for Implementation of AMR for electricity in housing sector in Poland was prepared by The Energy Regulatory Office and presented in December 2008. Total cost of full implementation of smart metering for measuring of electricity in housing sector is estimated on 7,5 bln PLN (appr. 2,0 bln €) with average price for LV meters of 470 PLN (appr. 124 €) per unit and for MV and HV meters of 2 500 PLN (appr. 660 €) per unit.. Potential profitability measured as a reduction of energy cost is estimated on appr. 100 PLN/year (appr. 26 €) per household.
Pilot projects and initiatives	No pilot projects identified.
Research and development activities	Some research and development activities related energy management systems for buildings and industry as well as on data transmission technologies.
Number of existing smart metering schemes (in operation)	Smart metering is already used on voluntary basis for industrial customers (with higher energy and gas consumption) and by DSOs in controlling and exploitation of distribution infrastructure (including gas systems).
Key features of the schemes	Automatic reading of consumption can be realised in any frequency. In most cases the communication is based on Gsmart metering, PLC or combination of those depending of the landscape and settlement.
Number of smart metering systems available	No limits for systems allowed to be used.
Number of smart metering meters and provisions of progress in increase of smart metering number	In industry sector appr. 40% of metering equipment is a smart metering one. Small number in devices in Service sector. No smart metering in housing sector.

5.2.8 Spain

Official country implementation plan	The Ministry of Industry establishes the Spanish official implementation plan for electrical residential customers on the law ITC 3860/2007 of 28 December 2007. Metering equipments roll-out has a time schedule of eleven years, from 1st of January of 2008 until 31st of December of 2018. The effective implementation of the AMM system must be ready before first of January 2014.
Law regulations related smart metering implementation – obligations, deadlines/goals	The Ministry of Industry has developed smart meter mandatory requirements for the 24 million residential customers called metering point type 5, which are customers with contracted power up to 15 kW, making public the functional and technical specification for electricity smart metering. The main functional requirements for smart meters are: - Active and reactive registration in any direction. - Hourly active and reactive energy load profile, with minimum data storage of three months. - Register outages longer than 3 minutes and the limits of the nominal voltage allowed. Remote power quality events. - Load control, remotely disconnection and reconnection. - Up to 6 programmable register for active, reactive and quarter of an hour maximum demand. - Only the utility must be in charge of programming the secret passwords. - Bi-directional communications. The protocols and communications haven't been specified by the Ministry, they are also utility's responsibility. - Remote reading management. - Remote synchronization with concentrators and central system. - Rates remote programming. - Alarms and events registration and storage. - The meter must store the last 3 billing periods. The billing periods could be done manually or automatically (locally or remotely). The main functional requirements for smart meters are: - The meter must fulfil with the Royal Decree 889/2006 of 21st of July of 2006. It describes the metrological control that the smart meters have to pass for active energy. It is similar to the European Parliament Directive 2004/22/EC of 31st March 2004 of measuring instruments, annex VII. - There isn't any technical requirement about standards, preferably these should be publics. - The utility could be able to use any communication protocol and interface protocols, i.e. RTC, Gsmart metering, PLC, etc. The meter should have an optical port for local communication and one display to read the consumption in the field. The local reading could be done through this optical port or through an optional serial port RS-232. Remote interfaces are not specified. - The firmware must be updated remotely or locally, the metrological

	part of the meter must not suffer any disturbance because of that.
Availability of smart metering technology	As the Spanish Ministry of Industry hasn't specified the smart meter in depth, Spanish utilities need to develop its own smart meter specifications with much more detail.
Economic profitability	There aren't any incentives from government side to the utilities to help them during the huge investment of the roll-out with the exception of a increase on the monthly rental charge of the meter to the customer from 0,54 €/month to 0,81 €/month.
Pilot projects and initiatives	There are pilot projects held by the three of the major Spanish Utilities: Endesa, Iberdrola and EON-Viesgo.
Research and development activities	As Spanish utilities need to develop its own smart meter specifications they are all carrying research and development activities.
Number of existing smart metering schemes (in operation)	Only one at EON-Viesgo with more than 150.000 meters already in operation.
Key features of the schemes	They comply with the requirements asked by the government.
Number of smart metering systems available	There are no limits for systems allowed to be used if they comply with the basic requirements stated. The more important requirements for Smart Metering System according to the Royal Decree 1110/2007 of 24th of August 2007 are: - Remote parameterization including time of use, and contracted power - Capability of activation power control mode: maximum demand meter or cut off element. - Power supply remote control: cut off and re-connection supply. - Capability of register load profiles. Allows to record measurement vectors in a flexible way (active and reactive energy, power demanded, current, etc.) selecting periodicity and relevant events to send to the concentrator to their management. - Meters Clock Synchronization remotely and periodically, through concentrators. - Available load management, to reduce demand response at critical moments. Power contracted or available can be programmed.
Number of smart metering meters and provisions of progress in increase of smart metering number	The Government defined the terms to execute the change to smart meters: Between the 01/01/2008 and the 31/12/2010: 30% of the domestic meters. Between the 01/01/2011 and the 31/12/2012: 20% of the domestic meters. Between the 01/01/2013 and the 31/12/2015: 20% of the domestic meters. Between the 01/01/2016 and the 31/12/2018: 30% of the domestic meters.

5.2.9 Sweden

Official country implementation plan	Legal requirement for monthly meter reading by July 2009 pushed DSOs to implement remote meter reading
Law regulations related smart metering implementation – obligations, deadlines/goals	DSO is responsible for metering. By 1st July 2009 all electricity meters must be read at least once a month for charging of actual consumption.
Availability of smart metering technology	Smart Meter technology is now fully available, but when implementation started several years ago many DSO's selected simpler technologies.
Economic profitability	Not normally considered because introduced by legal requirements. A few DSO's are now looking into extended and forward looking use of the installed Smart Meters.
Pilot projects and initiatives	Full nationwide implementation of remote meter reading is almost completed. There are some ongoing pilots with real time tariffs and new energy services by DSO's with Smart Meters.
Research and development activities	Some large DSO's are running internal R&D projects regarding use of Smart Meter data for enhanced grid operation. Yet no industry common R&D of any measures.
Number of existing smart metering schemes (in operation)	Every DSO reads meters remotely. The majority uses Smart Meters.
Key features of the schemes	The functionality and performance of the smart metering systems varies very much
Number of smart metering systems available	Many (more than 100)
Number of smart metering meters and provisions of progress in increase of smart metering number	Nearly 100% penetration of AMR in 2009, but about 10 - 15 % of these meters are in metering systems not capable of much more than monthly reading (= remotely readable but far from being smart metering). These systems will most likely be replaced during the coming years well before their technical length of life.

5.3. Deeper stories

Deeper stories are presented for chosen countries and cover the following aspects:

- historical background related to smart metering development
- current status and progress with implementation
  - Legal initiatives
  - DSOs and RESCs engagement and role
  - Consumers response
- barriers and drivers for smart metering development
- presentation of results of cost/benefit analyses
- policy and social aspects
- other supporting and legislative mechanisms
- promotional activities
- cooperation between industry and customers and other market actors
- role of policy makers
- goals and deadlines for future
- research and standardisation

5.3.1 Norway

According to the regulation at the moment of writing, all metering points in Norway should be read at least once a year, while Final Customers with annual consumption higher than 8.000 kWh should be metered at least quarterly, or alternatively every 2 or every month[v]. The most common way of manual metering is self-reading by the Final Customer. The response rate of self-metering varies between the different DSOs; from 61- 90 % and the missing data are estimated. The metered data are reported using the DSO's web page, telephone or postcard. Regulation about mandatory hourly metering for all Final Customers with annual consumption over 100.000 kWh was introduced on the 01.01.2005, and 4 % of all metering points and about 60 % of the whole electricity consumption in Norway are hourly metered today. Additionally, any Final Customers can require hourly metering of the electricity consumption from its local DSO, even if its consumption is below the mandatory threshold. In this the Final Customer should cover the costs for installation of technology, with a maximum cost of 2.500 NOK (300 Euro).

There are several arguments, supporting implementation of Smart Metering in Norway. From the Final Customers' point of view the energy saving possibility and correct billing of the consumption are probably the most obvious ones. This is mainly caused by direct electricity heating, which is commonly used in Norway, which makes electricity consumption in the residential sector very high: on average it is around 18.000 kWh/year per household[vi], while a single family house uses more than 20.000 kWh/year. The electricity system in Norway is solely based on hydropower, and years with low precipitation and accordingly high electricity prices have further reinforced these arguments. Similar to Sweden, the Norwegian Consumers' Council has been supporting the implementation of Smart Metering.

Norway has more than 100 functioning DSOs today. Since the start of the deregulation process in 1991 the number of DSOs has been decreasing due to mergers and takeovers, but the process is very slow. From the DSOs point of view, Smart Metering represents a possibility to reduce costs for collection of metered data, billing and settlement procedures. Therefore approximately 10-15 DSOs have already installed Smart Metering voluntarily for all their customers today, even though it is not mandatory required by the legislation[vii]

Public discussion about mandatory implementation of hourly metering or other implementation alternatives has been going on for several years in Norway. Since the late 90s different aspects of implementation of Smart Metering have been studied in several pilot projects. Project "End-user flexibility by efficient use of ICT (2001-2004)" and "Market Based Demand Response"[viii] (2005-2008) are the central projects, related to Smart Metering.

Mandatory implementation of Smart Metering was strongly promoted by the EBL Norwegian Electricity Industry Association. A deeper study supporting implementation of Smart Metering was conducted in 2006[ix] by EBL. The Norwegian Water and Energy Directorate (NVE) evaluated profitability of full scale implementation of Smart Metering in a new study and in July 2007 expressed support to implementation of Smart Metering for all Final Customers within 2013[x]. The Oil and Energy Minister Odd Roger Enoksen publicly supported installation of Smart Metering on the 21st of August 2007. At present the Regulator suggests in a discussion document concerning the regulations for metering and settlement, that AMR should be implemented to all customers in Norway by 1.1.2014. In the discussion document hourly metering of the total electricity consumption is suggested. The consultation round will end on 1. February 2009, and final conclusions concerning the new regulations will be published later in 2009.

NVE has earlier signaled that their requirements will be fairly general. Therefore a Smart Metering working group consisting of several DSOs and vendors has been established within the project "Market Based Demand Response". The group works on development of a more elaborated technical specification of Smart Metering Equipment, which will be voluntary. The Nordic AMR

Forum – a new common initiative from Norway, Finland, Sweden and Denmark works on harmonization of the functional requirements for Smart Metering among the Nordic Countries.

5.3.2 The Netherlands

General

On July 3rd the Dutch Lower House accepted a proposal for a two-step introduction of smart metering in The Netherlands. The proposal has now been sent to the Dutch Upper House for final approval. It is expected that from September 2009, The Netherlands will have legislation in place for the introduction of smart metering although there is strong opposition from the Dutch Consumers' Association based on concerns over privacy.

The proposal requires that all small consumers are provided with a smart meter for gas and electricity and that changes are made in the regulation of the meter market for small consumers. This will involve reallocating responsibilities among the various market parties and making meters subject to regulation. The regulated domain of the grid operator on the one hand will be made exclusively responsible for meter management: the installation and physical maintenance of meters as an integral part of the infrastructure. The supplier on the other hand (market domain) will be responsible for the administrative processing of consumption data. On behalf of their own customers, suppliers are required to ensure that measurement data is collected, processed and sent to the parties involved, as described under the *Meetcode*. This restructuring of the meter market – combined with the other elements involved in this Bill – will make it possible to significantly simplify and improve the administrative process involved in collecting and transferring measurement data.

Using smart meters creates a number of benefits. (Cost) benefits will be enjoyed by various parties (supplier, grid operator, small consumers). Each individual party is nonetheless only interested in a subset of the total number of benefits. For example, if suppliers were to roll out the smart meters, it is estimated that, for commercial reasons, only 30 to 35% of small consumers would end up having a smart meter. This is not desirable, because a number of benefits in the public interest – such as ensuring security of supply and efficient operational management by the grid operator – can only be achieved with a 100% rollout. So to ensure that these benefits are actually exploited, it is necessary for the rollout to be regulated.

Requisite functions of the meter

To ensure that smart meters are also beneficial for consumer and energy efficiency, it is important that all potential advantages are exploited as effectively as possible. For this reason, the statutory framework aims to position meters as an open platform for various services and users that are as accessible as possible. This will create a basis from which more than one party can offer its services to the customer.

Standardisation is also a key requirement in order to ensure that smart meters are suitable for the operation of the entire energy market. The meters that are installed must comply with the statutory requirements. Compatibility and interoperability must be ensured so that the functions of the meter can be effectively used by various parties without any unnecessary technical ramifications. For this reason, the Bill provides for a delegation provision that allows for more detailed output-related or technical requirements on meters in national government legislation. To this end, the *Nederlands Normalisatie Instituut* (Dutch standards institute) in collaboration with the energy sector and the parties involved defined the functionalities of the smart meter in a National Technical Agreement (NTA 8130).

In addition to the proposed regulatory rollout, the Minister of Economic Affairs and the Lower House of the Parliament also agreed on the following extra specifications regarding the smart meter:

Extra specifications ('Samson Six') for the meter, such as:

- More possibilities for own energy generating;
- A user friendly direct display for in home use;
- An alarm for unexpected peak usage;
- Real time measuring and use versus own generating of energy;
- Possibilities for remote programming of appliances such as laundry machine or dryer;
- Possibilities for communication with other meters.

As a consequence of this, the introduction of smart metering will take place in two phases:

- A two year 'start up' phase for new houses and large scale reconstruction according to the Directive,
- An 'acceleration' phase after discussing the 'Samson Six' and evaluating the other qualities of the present smart meters being used so far.

Other points of agreement between the Minister of Economic Affairs and Parliament are:

- The introduction of a standard bill for consumers;
- Higher volume (5000 kWh instead of 3000 kWh) for own generation of electricity;
- Timely billing by grid operators;
- Specifications for the meter need to be mandated by the Minister of Economic Affairs;
- No extra costs for consumers because of the rollout;
- More privacy protection.

Meter charging and meter reading

After the mandated rollout, to be expected by the end of 2016, every small consumer will have a standard meter complying with the prescribed requirements. It is expected that this standard will be assessed and upgraded to the latest technology every two to three years. Modifications can often be performed remotely on the software side, which supports innovation and significantly reduces costs. But even if meter requirements change in the future, making it necessary for the grid operator to make physical modifications to the existing meters, the corresponding costs are covered by the tariffs for measuring gas and electricity (meter leasing). These tariffs are set by the Netherlands Competition Authority. So, it is ultimately the Netherlands Competition Authority that decides when the cost of a major upgrade is permitted that leads to a change in meter leasing tariffs. The grid operator may charge a tariff specified in the regulations for the metering service. This tariff is set by the Netherlands Competition Authority, charged by the supplier in accordance with the proposed supplier model and paid to the grid operator.

According to the proposal, the energy supplier is the primary point of contact for small consumers. The supplier is itself responsible for obtaining and validating measurement data. Instead of being dependent on the grid operator whenever it received validated measurement data, the supplier can now exercise control over this process. To obtain the measurement data, the supplier can enter into an agreement with an authorised metering company. Other parties (for example measurement data companies, suppliers, energy savings consultants) are entitled to independently enter into an agreement with the customer under which measurement data is collected in the context of providing a commercial service. It is up to the customer to decide which party or parties – apart from the grid operator and chosen supplier– are to be given any additional access to the metering device or the (raw) measurement data obtained via the meter.

Impact on energy and cost savings

With the introduction of meters that can be read remotely, very accurate information on individual consumption will be available on a very frequent basis. However, simply installing a smart meter will not instantly generate energy savings. This Bill provides for a delegation provision that allows for national government legislation to define the frequency of feedback information. When defining the frequency of this information, it is necessary to take into consideration the quantity of information that is useful for small consumers and can effectively contribute to a change in their behaviour (saving energy).

The rollout of smart meters is expected to be an incentive to the market to offer energy saving services. Suppliers may also offer energy saving services either as a separate service or in combination with a supply agreement. This creates a link between the supply market and the market for energy saving services, which is expected to lead to greater product differentiation.

Therefore, the requirements set out for mandatory feedback also allow sufficient commercial scope for parties to offer additional feedback services.

In the light of these considerations, national government legislation can be introduced making it mandatory for suppliers to provide their customers with information on energy consumption over the period just ended compared with the same period the previous year at least six times a year. Any additional or more frequent information provided by the supplier or a third party would be optional. It is important to monitor the effectiveness of this obligation, so that any necessary changes can be made in the statutory frequency of providing feedback.

A further possible consequence will be the development of tariff products based on price differentiation per unit of time. This means that small consumers may choose from more than one tariff package during the day based on their consumption profile. Such a development would depend on a switch to billing based on interval data, not currently planned in the Netherlands. Another option is the prepaid function. It was found in practice that the prepaid meter was an effective instrument for these small consumers for gaining an understanding of their consumption and the corresponding costs. A further effect observed was significant savings in energy consumption. In countries, such as Canada and the UK, where this function is already in widespread use, it is particularly popular among consumers. The specifications of the smart meters allow for the prepaid function to be activated or deactivated depending on the wishes of the connected customer.

5.3.3 Germany

Introduction

In German Federal legislation the amendment of the Energy Economy Law (EnWG) [in 2008] brought about the quick liberalisation of meter reading services. According to the legal adaptation from 2010 it is obligatory for the metering service companies to install meters which collect actual consumption and time of use. This stimulates the wide spread installation of Smart Metering systems in households.

Due to the liberalized energy markets almost all of the 900 utilities in Germany do something with smart metering - mostly with technical goals and not for energy saving targets (at least not yet). There are also a couple of studies going on to assess the potential for energy saving with smart metering, and some few to study the specific form of feedback needed. Apart from the utilities, other companies from the ICT branch have started to step into the market of metering services, which was completely liberalized with the according legislation in 2008.

Still there is no clear picture, many technologies are competing and any effective technical standardization is not in sight. One aim of many stakeholders is the creation of a standard for the

MUC (Multi Utility Communication). Currently Echelon is the strongest player on the German market, but other suppliers seem to catch up now.

General characteristic of the situation and issues related to the implementation of smart metering in Germany are as follows:

- Residential sector has the most rapidly increasing end-use energy consumption (total end-use energy demand increased by 14% in the years 1990 - 2004)
- Electricity accounts for about 17% of energy consumption and it is of great primary energy importance (e.g. conversion losses)
- Electricity consumption increased by almost 20% (in the years 1990 - 2004)
- Managing the energy demand of this sector plays an important role in accomplishing the European energy and environment conservation targets

With regard to European law, art. 13 par. 1 of the directive 2006/32/EC on energy end-use efficiency and energy services makes no stipulations for particular meters or metering technique. With the general requirement, unlimited in the case of a new connection for a meter, binding obligations must be met with respect to the electronic metering of electricity consumption, so that all end-users are provided with competitively priced individual meters which reflect the final energy consumption time. Further noticeable requirements are visible regarding the requirements for electricity billing. This covers, on the one hand the overall amount and additional information gained by comparative evaluation, and on the other hand, billing in regular intervals of less than a year. This means that implementation measures are necessary at the national level. The directive 2006/32/EC was transferred into national law on 17. May 2008. Germany recently proposed a new energy law requiring all new and modernised homes to be equipped with smart meters by 2010 to promote energy conservation and efficiency.

The analysis of the legal framework for smart metering shows several gaps and legal uncertainties, which influence the general situation leading to delays in a nationwide implementation of smart metering. The regulation of the liberalisation, the metering process and the metering itself is insufficient:

- The material and formal requirements regarding the metering process are not satisfactory for providing a reliable and supportive framework for the distribution of smart metering.
- The standardization regulations of metering techniques, processes and data formatting, which for the most part are based on association guidelines, are particularly problematic.

- The legal requirements governing the billing of electricity consumption and the fixation of energy tariffs are insufficient.
- In order to eliminate the current discrimination within the calibration of electronic meters compared to analogue meters (valid at the moment only for 8 years as opposed to 16 years), the calibration intervals should be fixed separately within the calibration act.

With regard to the transferral and implementation of art. 13 of the directive 2006/32/EC, the following necessary regulatory and optimization measures (aimed at the elimination of the problems mentioned above) should be considered:

- Revision and unification of the energy related regulations concerning the contents and definitions of the metering operation and metering itself, the reading of the meter and the distribution of data.
- With regard to the optimization of the liberalisation of metering in general, there must be an ordinance concerning the third party operation of the meters and an ordinance concerning the liberalisation of metering. Legal uncertainties and regulation gaps can be eliminated by regulating details, frame conditions and procedures pertaining to both business sequences, on the basis of the authorization for an ordinance in § 21 b par. 3 of the German Energy Act (Energiewirtschaftsgesetz – EnWG).
- It is expected that a regulation of so-called basic requirements for meters and data formats should take place. This would lead to improvements in competition in the field of metering, in particular through optimal coverage of wide ranging potential for energy saving, and further economic and technical advantages through smart metering.
- As a means for raising the level of awareness among customers for their energy consumption and for indirectly forcing the introduction of intelligent meters, introduction of the requirement for informing householders monthly about their level of energy consumption seems reasonable.
- Further, minimum requirements concerning the configuration (form and content) of the billing process should be enforced. These should cover both the areas of basic supply and special customer relations.
- Finally, a regulation of minimum requirements or restrictions regarding energy tariff composition seems to be necessary.

- Introduction of a ban on tariffs supporting high energy consumption, the requirement to offer tariffs for periods of low energy demand or energy saving tariffs must be considered.

German market trends

Starting in 2011, German utility companies will have to provide load-based or time-of-day-based power saving incentives. All major German energy suppliers are now testing smart meters, but it is estimated that so far only 0.01 % of all meters are smart ones. The reason for the hesitancy is that (according to a study by Accenture, a consulting firm) replacing one-fourth of the electric meters in Germany would cost about € 1 billion and take 5,000 person-years.

Planned pilots:

- SVO Energie: Start November 2007, 575 households
- Municipal utility Schwerte: Start mid-2006, 500 households
- EnBW: Start end of 2007, 1000 households
- MVV Energie AG: Start early 2008, 20 households
- Vattenfall: Start early 2008,1000 households
- RWE: Start mid-2008, 100.000 households (see appendix!)
- Yello: Start mid-2008
- RheinEnergie Köln: Start 2009, 2010 extension to all (1 million) private customers
- Numerous other (small) projects

However, no big rollout is scheduled so far and German legislator rejects proposals for mandatory rollouts. This does not concern new energy law requiring all new and remodelled homes to be equipped with smart meters by 2010 to promote energy efficiency.

Feedback

In Germany pilot projects and public consultations regarding larger implementation of smart metering are just starting to be on the agenda of DSOs and suppliers. The main features and approaches to the issue are as follows:

- Some of pilot projects are focusing on smart metering of both electricity and gas.
- Some of the bigger suppliers implemented innovative smart meters and feedback systems. It is remarkable that they are not using standard meters available on the market but systems developed partly in cooperation with research institutes.

- In all analysed cases, it is meaningful that web portals are being established for customers in order to communicate customers to allow them to monitor their present and past data on energy consumption, costs and CO_2 emissions. Additionally customers are also receiving trend forecasts on the basis of consumption data of the past year and they are able to compare their actual consumption with past consumption data.
- EWE AG for example has developed its own mobile display that receives real-time and past data from smart meters via wireless radio signals.
- In some projects customers are receiving above mentioned information via monthly bills.

Main activities at the moment are related to realisation of pilot projects and gathering experiences before smart metering solutions would be implemented in large scale in whole country. An example can be activity of RWE described in Appendix 1.

5.3.4 Ireland

Ireland is a nation of about 4 million people with a distribution system that delivers electricity to more than 2 million domestic, commercial and industrial customers. The system comprises of over 170,000 transformers and almost 150,000 km of distribution networks.

The electricity use in the last decade increased significantly by 49% and even 52% during peak times. Reduction of the problems related to this situation is one of more important topics for the Irish Government at the moment.

The Irish Government remains committed to a full roll out of smart metering to all market sectors, and is in agreement with ESB Networks (which is the main DSO - responsible for supplying power to 1.8 million customers in Ireland,) and other stakeholders. The National Smart Meter Plan (Nsmart meteringP) assumes that its implementation can lead to average savings of €500 on energy bills a year, and save three tonnes of carbon per home due to less necessary power generation[xi]. These figures comes from the results of the Power of One Street project[xii], where the triallees were reported to have saved €500 each in 6 months[xiii]. There has been a decision to extend the scheme to include gas metering.

The Ministry of Energy also announced details of the €1bn plan to have all homes smart meter enabled by 2013. It was initially assumed that householders may have to pay €100 during this implementation for the smart meters to be installed.

In 2008 a trial project was started covering 21,000 household and within this 15,000 homes are going to be assessed free of charge on how the smart meter technology would benefit consumers. Another 6,000 houses are going to be extensively tested for behavioural use of electricity in preparation of the project. The pilot trial project will take off in 2010 and meters from four different international companies are going to be installed and tested.

There are also other national trials as part of the preparation for the proper introduction of smart metering to Ireland. They have been split into customer response and technical trials. The trials are being chaired by the regulator and there is a steering group comprising the main stakeholders.

At present 400-500 meters have been installed and the expectation is that there will be 4000 - 5000 by the end of the year 2009. Of these, 3000 – 3600 are in the residential customer trials. The meters in the customer trials are using smart metering communications but the technical trials are trying all options including PLC and wireless mesh.

The trials are assessing the impact of 5 different time of use tariffs – the primary objective is to identify when the peak price should be for maximum effect. They are also looking at monthly and bi-monthly billing and customer feedback and expect meters to have an interface to a home network. The trials will be run from June 2008 until the end of 2009.

It is believed that the largest environmental benefit will come from avoiding the use of peak generation capacity. At present, though, there are no capacity constraints for the Irish power supply. An additional cost estimated on approx. €2.5 billion is connected with the necessary investment program currently under way by ESB Networks to upgrade Ireland's electricity infrastructure, with completion due in 2010.

There are also considered to be other important aspects e.g. related market regulation.

Power providers in Ireland will have to decide quickly on which technologies they choose to use in order to fall within government mandates that have recently been passed in 2008.

It was also stated that The Commission for Energy Regulation will periodically review the cost ESB Networks incurs in maintaining and operating the distribution system to ensure that only equitable levels of costs are collected through the distribution tariffs. The distribution system tariffs that are charged to electricity consumers will continue to be reviewed annually.

The Irish regulator also requires a full evaluation of the options so that the optimum system for smart metering can be designed for Ireland and the relative contributions allocated. For instance, the level of impact resulting from time of use pricing will dictate the costs that can be allocated to customers.

6. Energy Savings and other Benefits Attributed to Smart Metering Systems

There is general acceptance of the potential benefits attributed to smart metering systems for different stakeholders:

- For final customers to increase energy awareness and decrease energy use and energy cost.
- For metering companies or DSOs to decrease meter operation costs.
- For grid operators who want to prepare their grid for the future.
- For energy suppliers who want to introduce new, customer made services and reduce call centre cost.
- For governments to reach energy saving & efficiency targets and to improve free market processes.

6.1. Benefits related to energy savings

Smart Metering is a technology where end-use energy efficiency can be encouraged. Smart Meters can give consumers, at an affordable cost, clear and comprehensive information about their energy consumption and, giving them better information, can help consumers become more energy efficient.

However, installing Smart meter will, by itself, do nothing to save energy since the meter itself is simply an “enabler”. Energy savings will only be achieved if installing the meters results in consumers actually changing their behaviour so as to use less energy in total.

Smart meters systems also provide useful information to distribution network operators. This information can be used to better manage networks thus reducing network losses.

While today the main concern of the utilities is the reliable supply of energy (of different forms), tomorrow will also add responsibility for the provision of energy services to realize energy savings as the ESD prescribes (it instructs member states to oblige energy retailers and distribution operators to offer - directly or indirectly - energy services which will lead to verifiable and monitorable energy savings).

The pre-condition to this is receptive customers’ with a willingness to modify their behaviour in favour of lower energy use (or willingness to be persuaded). This behaviour can be developed through well-targeted information campaigns and the introduction of further stimuli (like reward for the protection of the environment) which will incite customers to take the desired actions. But experience suggests that the motivation towards energy savings must be “refreshed” on a permanent basis otherwise the effect of more cautious energy use may erode over time. It can be expected that, in order for energy savings to be realized, financial incentives (possibly state-supported or mandated) will also be introduced to make energy saving measures more attractive in economic terms.

The typical demand response is a voluntary reaction by the final customer to a price signal, for example delaying electricity demand by hour (load shifting) or to avoid an extreme price peak (peak clipping).

The introduction of time varying and dynamic pricing can be accompanied by the installation of remote/automatic load control devices/programs. This can maximise the desired load reductions and avoid the need for the customer to take any action.

The typical end uses which may be subject of such remote switching/control are space heating and cooling (or generally “conditioning”) systems or electrical boilers for water heating. More advanced load control programs may also regulate lighting sources and more intensive electric appliances with adjustable time of operation like washing machines and dishwashers.

Apart from areas where there are severe supply constraints, the benefits of demand response are in general not enough to justify large scale smart metering investments alone. However demand response can be an important part of the business model combined with operating benefits, energy efficiency and other elements.

Estimates of likely benefits are needed to justify and design investments in demand response and smart metering. The potential for energy savings can be expected to be different from one final customer segment to another and from one country to another. The current literature throughout Europe gives mixed results about the possible savings. Therefore it can be relevant to perform field trials to test innovative combinations of smart meters and feedback mechanisms. Often utilities use trials to assess the energy savings that they can expect from implementing smart metering and this figure can be an important factor in justifying (or not) smart metering and for allocating the contribution of customers.

Estimating the benefits of demand response can be split into estimating the value of response and estimating the size, dynamics and reliability of the response. It is also necessary to understand the tariff variations that customers need to motivate them to join a scheme or respond in a dynamic scheme.

6.2. Other benefits

Smart metering has a range of other possible benefits not only for final customers, but also to suppliers, metering companies, grid operators and governments.

Smart metering systems may benefit **final customers** in many other ways. The most important are:

- More accurate meter reading and billing and fewer customer complaints because with smart meters bills are based on real rather than estimated consumption.
- Better service quality as the availability of individual service quality measurements allows regulators to design new penalties/incentives to improve the performance of distribution network.
- Easier to change supplier because, as meters can be read at any time on request, it reduces delays for switching to take effect.
- Increased competition among suppliers as suppliers are able to offer customized contracts and added-value services.
- Ability to manage consumption as smart metering systems allows customers to remotely control devices that are able to communicate with the meters.
- The ability to install micro generation measures without new metering arrangements.
- The possibility for prepaid or post paid schemes and easier credit, either by phone or internet for pay as you go meters.

Smart metering systems also offer **suppliers** with several advantages, such as:

- Customized prices: Smart metering allows the supplier a better knowledge of the consumption pattern of individual customers, giving them the opportunity to target them with different prices options.
- Easier change of supplier process through automation of meter reads increases the speed of the process.
- Fewer billing complaints as they are based on real rather than estimated consumption and can be resolved online.
- Fewer bad debts as smart metering allows remote cut-off and reconnection.

Smart metering also reduces operational costs to **metering companies** as different tasks like readings, connection and disconnection, tariff programming, alarms management, clock synchronization and/or firmware update can be done remotely.

The **grid operators/DSO** obtain several advantages from smart metering systems, such as:

- Faster identification of location and restoration time as with smart meters the DSO automatically knows where the power is out and can dispatch crews to restore it without having to wait for customers complaints.
- Better detection of technical and non-technical losses due to better information of the low voltage distribution network and the alarms incorporated on the meters

- Grid voltage and phase monitoring
- Optimization of the distribution network due to better knowledge of it.

To end up, smart metering systems offers additional benefits for **governments** as it helps to reach energy saving & efficiency targets, improve the security of supply and ease free market processes.

7. Advances in Smart Metering Technologies and Systems

7.1. Developments in Smart Metering Technology

7.1.1 Introduction

This chapter of the annual report covers relevant developments in smart metering technologies that occurred (or were announced) during 2008. The purpose of the chapter is to inform any interested stakeholder on the key changes that have occurred in smart metering technology that may have a bearing on its future implementation and/or functionality.

In order to allow the report to be completed, a closing date for inclusion of items in the report was set at the end of October 2008. However, there have been a small number of developments that occurred after that date but before the report was finalised that were so significant that it seemed necessary to include them in this report.

The scope of the news items included has been drawn from the ESMA definition of smart metering[xiv]. Developments that only relate to AMR (remote meter reading) or basic meter functionality have been excluded unless they have implications for smart metering.

Reflecting the nature of smart metering and its extension across a wide range of related technologies, the chapter has been broken into a number of sections that relate to general topics. For each of these the author has attempted to describe a general trend, illustrated by a number of specific instances. The chapter begins with an overview of the trends and the main highlights of the year.

7.1.2 Overview

A key observation on the developments that have been seen in 2008 is that there is considerable activity in the US and Canada. This has been driven by growing concern about improving energy efficiency and the widespread installation of wireless enabled meters. The US is often believed to be only concerned with demand management but this is increasingly outdated and the reader will find much about energy efficiency from the US in this chapter. Certainly there are very large implementations of smart metering underway or being announced in the US and Canada.

Of note was a workshop held at Stanford University, the Stanford Energy and Feedback Workshop Sept 4th and 5th Sept 2008 (link). The proceedings from this workshop are notable for the innovative approaches to customer feedback; allied to some of the customer facing software used for the internet and web sites.

Activity is increasing in Europe with growing numbers of trials of displays and other feedback routes. Often though, these displays use separate transducers to measure the power as there is no access to the meter data. It can be anticipated, though, that much of the learning being gained regarding how to effectively present data to customers can be applied to meter connected displays as soon as AMM meters are widely available.

One conclusion from these developments is that Europe is not in the lead in implementing customer feedback and related technologies and may fall behind other parts of the world unless it accelerates its support for research into customer feedback and ensures that it is included in smart metering roll outs.

The other major issue around smart metering in Europe is the issue of interoperability. In the US and Canada market design means that interoperability is less important as smart metering systems can be in independent networks under the control of the local utility. In Europe, though, the need to ensure an open market for meters and energy supplies makes interoperability a much more serious issue. It can be seen later in the chapter that major initiatives are underway to address this issue.

A final observation is that, despite the comments above, there is a great deal of activity in Europe now developing customer feedback technology with a number of different approaches being pursued. Future versions of this report look forward to tracking future developments in this field.

7.1.3 Meters

The main theme observed in meter development is a general simplification of the technology. Meter components are being developed that allow a lower component count, energy consumption and costs. This is being achieved by the simplification of general purpose devices, such that only the features really needed are provided. This also makes smart meter roll outs more reliable as there are fewer opportunities to mis-program the meters. Meter component counts are also being reduced as additional functionality is added to the ‘standard’ components. It can also be seen that greater functionality is being provided by the addition of chip families specific to the requirements of energy efficiency, such as local interfaces and data stores.

7.2. Advances in data transmission technologies

The field of communications is undergoing constant change; however, the previous year has seen no significant developments. A number of future possibilities have been raised relevant to smart metering. A proposal has been submitted by Strathclyde University for a smart metering communications system based on small satellites. There has also been some interest in the use of FM radio communications for meter communications. FM is lower frequency than usually considered for smart metering, which would limit the maximum possible data rate but it has much better propagation properties so that there would be a reduced need for concentrators. One major issue would be the size of aerial needed on the meter.

7.3. Advance in data processing technologies

7.3.1 Interoperability

Smart metering Interoperability has been a major topic during 2008. It has been recognised that interoperability is a critical issue that must be resolved. This has been driven by the need to ensure an open market in Europe for energy suppliers and for meters. In particular, there has been much concern over the need to reconcile the Measuring Instruments Directive[xv] and the desire of member states to mandate smart metering. The MID sets the minimum essential requirements for meters and national governments and equivalent bodies are not at liberty to require a higher specification. The favoured solution for this impasse is the development of harmonised European standards covering all the elements of smart metering that might need to be specified. A number of activities have occurred to progress this aspiration.

- The Commission allocated funding under the FP7 programme for a project on interoperability for smart metering. It is understood that this has been won by the Open Meter Project led by Iberdrola Distibucion with other industry stakeholders. Details of the project are: Participants: ACTARIS, ADD. CESI RICERCA, CURRENT TECHNOLOGIES INTERNATIONAL, DLM USER ASSOCIATION, EDF, ELSTER, ENDESA, ENEL, ESSENT, KEMA, LANDIS+GYR, RWE, ST MICROELECTRONICS, UNIVERSITY OF KARLSRUHE, USYSCOM, ZIV MEDIDA, CENELEC. The project scheduled start date is 01/01/2009 with a duration of 2 years.
- The European Commission has proposed a mandate for CEN/CENELEC/ETSI to develop the necessary harmonised standards to support smart metering – “Standardisation mandate to CEN, CENELEC and ETSI in the field of measuring instruments for the development of an open architecture for utility meters involving communication protocols enabling interoperability”. This was sent out for comment by national governments with a deadline of 22nd January 2009.
- CEN/CENELEC/ETSI have recognised the European Smart Metering Industry Group (ESMIG) via a Cooperation Agreement between CENELEC and ESMIG, the European Smart Metering Industry Group. ESMIG was established in 2008 and represents vendors active in the field of smart metering. The membership of ESMIG extends across the field of smart metering and well enables it to develop the standards that will be needed to support smart metering.

  Link to ESMIG
- SAP has established the SAP AMI Lighthouse Council in a grouping with seven major utilities. These are mostly American but include EdF. The grouping also includes a number of vendors.

Link to SAP AMI Lighthouse Council

The initial focus of activity in the various groups has been to identify the existing international standards that are available to support smart metering. Once this exercise has been completed the various groups will move on to identify any missing elements and then set in train the development of the required standards.

7.3.2 Protocols development

ZigBee Smart Energy Application

The ZigBee Alliance has published their Smart Energy Application for wireless communications between smart devices. ZigBee can be used for both local communication and to communicate data outside of homes to local concentrators. As will be seen in the section on displays, there are already ZigBee enabled devices coming onto the market, mostly displays and programmable thermostats.

Link to ZigBee (http://www.zigbee.org/en/index.asp)

Z-Wave new Advanced Energy Control Framework (AEC)

The Z-Wave Alliance has announced a new Advanced Energy Control Framework (AEC) that seems to be similar to the ZigBee Application. Z-Wave is more suited to in home use so its application is more likely to be restricted to the Home Area Network (HAN).

Link to Z-Wave (http://www.z-wavealliance.org/modules/start/)

7.3.3 Integration Software

In the absence of a unifying set of smart metering standards, a number of approaches to implementing smart metering have been pursued. One that has been successful is developing software packages that allow meters from different manufacturers and using different protocols to be integrated into a single system. This is achieved by treating the meters much as devices on a PC and providing driver software that manages communication with the meters. This allows the high level software to communicate with the meters without the user having to know what sort of meter is being addressed. A number of product developments have been announced in 2008 of such software. Examples of this are the Maxim Integrated Products – Sagem Communications

7.3.4 Smart Homes

The main development relevant to smart homes has been the release of the ZigBee Smart Energy Application and the release of compliant products. Z-Wave has also announced the new Advanced Energy Control Framework (AEC) which is running in parallel with the ZigBee developments. It is still not clear which of these technologies will come to dominate or whether they will share the market. If the progress of the US market is to be followed, then it may be that the protocol used by the meter manufacturers to communicate with their meters and other utility meters will come to dominate in the smart home as manufacturers produce devices to exploit the meter interface and HAN.

7.3.5 Alliances

Any survey of developments during 2008 would not fail to note the large number of alliances announced. Generally these have sought to extend the scope of the vendors involved. Smart metering has a long reach from the meter all the way through to the back office and no vendors cover all elements of this chain. In the absence of an interoperable framework, vendors have needed to form alliances with other companies to offer their customers end to end capabilities. Other alliances can be seen to extend existing proprietary solutions to provide more functionality or more choice of vendors.

Examples of the former are:

- An announcement that Google and GE are collaborating to for a smart grid alliance. The involvement of Google is significant given their experience of handling and presenting large amounts of data to the general public.
- In Europe, Landis + Gyr has linked to Generis, vendors of backend meter management and billing software while in the US, Landis+Gyr has linked with Eka Systems to integrate Landis + Gyr meters into the EkaNet Smart network AMI solution.
- Powell a utility software vendor has linked with Founter, providers of meters to offer a end to end solution.

and of the latter:

- In the US a link between Elster and Landis + Gyr integrating Landis + Gyr meters into the Elster EnergyAxis mesh radio network. .
- A link between Elster and Itron to accept Elster meters onto the Itron OpenWay software system. This has been further enhanced by an announcement that Itron would work with Silver Spring Networks to integrate OpenWay software with Silver Springs smart energy networking solution, extending the scope into smart grids.
- Powell has allied with Cordys to offer EKKO, which adds work flow management capability to Powell's software.

7.4. Customer feedback and displays - applications development

This is a very active area for technology development. It is clear that a number of different options are being explored and these have been set out below. It is not intended here to list all such devices but rather to pick those that illustrate different approached or novel features. All of the different designs and approaches have been summarised in the Table at the end of the section. First, though, key developments in the various approaches are examined.

7.4.1 Consumption feedback via internet access

One approach to energy feedback is to give customers access to the meter data held by the utility via a web site. This data can be displayed in a number of ways, such as in charts and tables. The data can also be linked to energy analysis software that allows the customer to enter the details of their energy usage and property. This in turn allows the web site to offer energy reduction advice and comparisons with other customers' usage.

Advances noted in this report are focused on early offerings of such web site feedback. Many utilities currently offer energy analysis software for customers to model their usage. However, these can be very time consuming to fill in. The availability of smart meter data can simplify and speed this process.

Modstroeam

This is a significant advance that occurred during 2008. The Danish Electricity Savings Trust (DEST) has established a new web site that customers can use to analyse their energy consumption. It is written in Danish and English and all users are welcome to access the site. The site has been developed with the Z-Wave Alliance so that the software can accept and control Z-Wave enabled smart home devices, such as thermostats, switches and meters. The web site will also accept meter data from participating utilities when smart meters have been fitted. The web site links to a range of energy savings advice measures and product web sites.

Link to my-home

(http://www.savingtrust.dk/consumer/tools-and-calculators/my-home/about-my-home/index_html)

In the US and Canada, where remote reading of meters is more common, web sites that allow customers to view their usage are being introduced. Notable examples are the Deleware Energy Depot and the ConectiSys Corporation H-Net. The H-Net site features a demonstration of a simple web page and energy usage tracking. It has hourly data in table and chart format, it has daily, weekly, monthly, annual data plus a monthly bill forecast.

Link to Energy Depot (http://www.energydepot.com/DEMEC/index.asp)

Link to H-Net

(http://www.conectisys.com/UTCWeb/Meter-Data/B_Consumers/Search_Engine_Pages/demo_index.php)

7.4.2 Displays linked to meter data

Numerous energy displays have now been developed and put on the market. These have used a variety of different approaches to providing customer feedback and are examined in the section below.

A notable development in recent years has been the emergence of ZigBee enabled displays in the US market, such as the Tendril Insight, Ambient Home Joule and the Aztech In-Home. Some of these are based on the new ZigBee energy profile and depend on the widespread installation of Zigbee enabled meters by US utilities. These displays can be offered by the utility or directly to the customer. This trend gives a glimpse of how the European market might develop if AMM meters were widely installed and were fitted with a standard local interface. It can be expected that the competing network protocols will seek to emulate the growth of the ZigBee device range.

A number of these devices also link to software packages allowing the customer to carry out more detailed analysis. Some US utilities are also providing access for customers to web sites where they can see their energy consumption, current and predicted future bills and guidance on making energy saving measures. Some of these sites, such as the Greenbox, claim to provide real time energy usage data.

Although not widespread, meter linked displays are being developed and tested in Europe. The ecoMeter from Landis+Gyr is being used in a large number of trials. The PowerPlayer is being developed for use in the Netherlands and has been based on EMSA feedback conclusions.

EcoMeter

The EcoMeter was developed by Landis+Gyr in Australia and has been brought into the European market. It is being widely used in smart meter trials, notably in the UK Energy Demand Reduction Project. The display has wireless links to electricity, gas and water meters as well as offering two way communications with the utility.

Figure 1 EcoMeter

PRI Home Energy Control

An interesting example of how the technology may develop is the PRI Home Energy Controller. This is based on the ZigBee energy profile and provides both feedback and control of the central heating system. Much of the interest in smart metering in the US is driven by concern over air conditioning loads and technology is being developed to manage this load. However, this is an insignificant residential load in Northern Europe, where heating, often gas, is the major residential load. The PRI HEC is an indication of the sort of smart home devices that can be expected to be supplied for this market.

Figure 2 PRI Home Energy Controller

PowerPlayer, The Netherlands

The PowerPlayer has been developed as part of the roll out of smart metering in the Netherlands. The approach to the design has reflected the conclusions of the analysis of feedback carried out by ESMA[xvi] and features a simple and clear display.

Figure 3 PowerPlayer

EWE- Box

This is an energy monitoring system that has been developed by the Frauenhofer Institute for Solar Energy Systems, ISE. This is being trialled in Germany by the utility EWE and provides feedback on the customers electricity and gas consumption.

Figure 4 EWE – Box

AzTech Insight

The AzTech Insight is a good example of the different approaches to displays being explored by different developers. It uses a ZigBee wireless link to connect to the meter and other ZigBee enabled devices in the home. The display provides two way communications to the utility and provides updates on tariff rate changes. The display has a multi-coloured bar on its top that can be used to provide additional feedback. The designers have likened the display to an electronic game console and have reported a good reaction by children to the display and energy management.

Figure 5 AzTech Insight

Tendril Insight

The Tendril Insight is a one of a number of displays that have been designed to use the ZigBee energy profile to link with ZigBee enabled meters and access the meter data. Other examples are the L.S. Research RATE$AVER and the AzTech In-Home.

Figure 6 Tendril Insight

7.4.3 Displays with non-meter data sources

Despite this early work on displays linked to meters, in Europe the tendency has been for displays to be developed that are independent of the meter as there is currently poor local access to the data in the meter. A similar market is apparent in the US, where the local meters do not allow access to data. The majority of these displays utilise a split current transformer to measure the power flow at the meter. A few, such as the Meter Reader EM 2500, also measure voltage so that an accurate power value can be determined. These displays normally have a wireless link to a display. A number of the displays also link to computer packages to allow detailed analysis of the data.

It might be noted that, although the displays have no access to the meter data, designers have been able to explore a variety of feedback options. It is also reasonable to assume that the display manufacturers will respond rapidly and release displays with meter links when meters are installed with standards based internal interfaces. This means that the work being done on separate displays can be rapidly transferred to linked meters when meters fitted with interfaces are fitted.

Wattson

The Wattson is a distinctive display that has been developed in the UK. It features a very simple display with just the cost or consumption displayed. The unit can link to the Holmes software package which offers opportunities for more detailed analysis.

Figure 7 Wattson Energy Monitor

Energy Orb, (Ambient)

This is an interesting display as it has no numerical output but uses changes in colour to indicate the energy consumption. This device is on sale in the US and there are reports on the internet of customers re-working it to connect to the utility meter rf output.

Figure 8 Energy Orb

Sentec – Coracle

The Sentec Coracle is an interesting development that features signal analysis capability that is used to separate the electricity usage patterns of the different power loads in the property.   Each energy load and appliance has a unique signature that can be detected in the power signal at the meter. By detecting these signatures the Coracle can provide the customer with a detailed breakdown of their energy usage by application, potentially much more useful information in helping to find savings. In order to detect the signatures the analysis routine has to have access to a high resolution wave form. This means that such waveform analysis routines will need to be embedded in the meter or have direct access to the power signal.   This approach would not work if the analysis were carried out in a separate display. This implies that such functionality will depend on links to the utility, so as to give access the meter. Notably, Sentec has entered into a contract with Scottish and Southern Power in the UK, one of the major UK Suppliers.

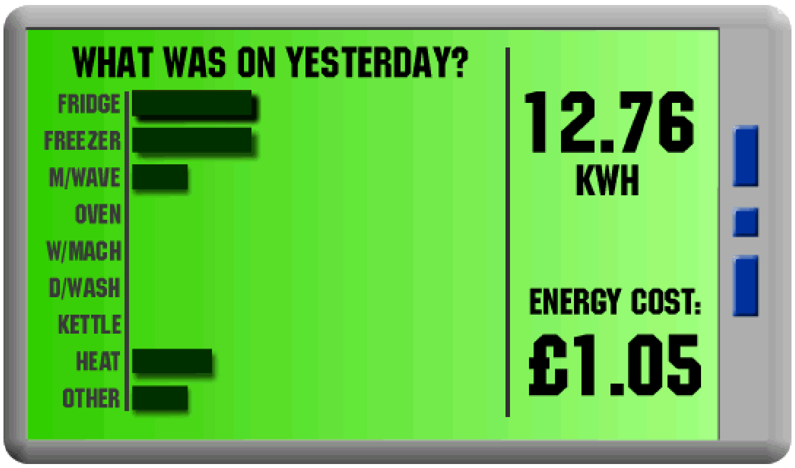

Figure 9 Sentec Coracle

Green Energy Options – Home Energy Hub

The Home Energy Hub has been developed to provide an attractive an intuitive feedback display for customers. It has the option of adding additional modules to provide feedback from individual appliances and the heating system.

Figure 10 Home Energy Hub

7.4.4 Summary

It should be clear that there are a large number of different customer feedback developments and that these are trying a variety of different approaches to offering feedback. It can be expected that the relative effectiveness of the different approaches will become clear over the next few years. It is also possible that some of the different approaches may find particular market or geographical niches. Future editions of the ESMA annual report will track this progress.

To provide a benchmark for future reviews of progress a comprehensive summary of the feedbacks known to the ESMA project team are presented in the table below.

Display Name	Data Source	Customer Interface	Features	Link
Internet based				
Modstroeam	Utility, ZigBee device, manual entry	Web site	House energy analysis, link to ZigBee devices for home automation and data collection, link to participating utility meter data	DEST
VEAB EnergiKollen	Utility	Web site	Customers can view their energy usage and compare this with other users	VEAB
DTE Energy MyEnergy Analyzer Based on Aclara EnergyPrism	Utility	Web site	Customers can view their bills, energy usage, get advice on energy reduction. The utility can target specific customer groups	EnergyPrism
Energy Depot	Utility	Web site	Allows customers t o calculate their predicted energy costs, compare with bills and analyses cost saving measures	Energy Depot
Greenbox	Utility	Web site	Provides real time feedback and allows customers to identify savings opportunities. Links to ZigBee network to provide control function	Greenbox
H-Net	Utility	Web site	Customers can view their bills, energy usage and forecast future usage	H-Net
In-house displays linked to meter data				
ecoMeter	Meter and utility data link, wireless or wired	Display unit	Shows multi utility meter outputs, cumulative demand, coloured lights related to consumption level and communications with utility	ecoMeter

Display Name	Data Source	Customer Interface	Features	Link
PowerPlayer	Meter via wireless link	Display unit	Shows energy usage, carbon for electricity and gas and forecast costs	
EWE Box	Meter via M-Bus	Display unit plus web site	Weekly or daily consumption on display, annual and monthly data on web site.	EWE Box
EMS-2020	Meter via wireless link	Display unit	Daily and monthly display of energy and costs	EMS-2020
PRI Home Energy Control	Meter via wireless link	Display	Multi utility display of instantaneous and cumulative multi utility data. Can control heating system	Home Energy Control
Home Joule	Wireless connection to meter and utility AMM network	Display mounted on plug top	Display shows consumption, weather forecast, current electricity tariff and coloured light indicating the relative cost of power	Ambient
AzTech In-home	Wireless link to meter	Display and optional link to computer software	Display shows instantaneous or 30 day rolling average consumption and cost. Has light to show level of consumption. Can control thermostat via ZigBee interface	In-home
Tendril Insight	Wireless link to meter	Display	Instantaneous and cumulative energy and cost plus forecast monthly bill. Communications with utility	Insight
HEMS Technology HEMS-DR	Wireless link to meter (L+G Focus meter)	PC	Comprises a wireless mesh linking meter, socket monitors and thermostats, these can be monitored and controlled	HEMS-DR
L.S. Research RATE$AVER	Meter via wireless link	Display	ZigBee energy profile compliant display, shows current and cumulative	RATE$AVER

Display Name	Data Source	Customer Interface	Features	Link
			consumption and has level alarm	
In-house displays linked to separate power transducer				
The Energy Detective	Current transformers and wireless link to display.	Display, this unit also links to software package called Footprints	Has voltage pick up to provide true active energy measure	TED
Eco-eye	Current transformers and wireless link to display.	Display	Display shows consumption, cost and carbon and can store data to give cumulative data	Eco-eye
Wattson/Holmes	Current transformers and wireless link to display.	Display, this unit also links to software package called Holmes	Display shows consumption, cost and carbon, software package stores data to give cumulative data	Wattson
Energy Orb	Wireless link to Internet	Coloured glass globe, colour is linked to energy consumption or energy price	Very simple user interface, can be modified to display energy usage data	Ambient
Sentec Coracle	Power analysis of supply with wireless link to display	Display with options for web access to data	Calculates disaggregated appliance usage from total supply signal	Coracle
Green Energy Options Home Energy Hub	Current transducer at supply point and point of use transducers with wireless links	Display, simple option or duel option with heating, hot water and individual appliance loads	The advanced options allows for control of appliances via smart plugs.	Energy Hub
Wattwatcher	Current transducer at point of supply with wireless link to display	Display and link to computer programme for energy analysis	Option for additional appliance sensors. Part of larger programme with community and web site support	Wattwatcher
Cent-a-meter (Australia) Owl (UK)	Current transducer at supply point with wireless link to display	Display, shows instantaneous power, cost and carbon plus temperature and RH	Display has option to accept multiple inputs.	Cent-a-meter
The Meter	Current	Display showing	1% accurate through	EM-2500

Display Name	Data Source	Customer Interface	Features	Link
Reader EM-2500	transducer and voltage sensor with wired link to display	power, peak power, estimated bill, voltage	measurement of voltage and current	
Current Cost	Power transducer with wireless link to display	Display showing instantaneous and cumulative power and cost	Optional link to computer package to review consumption	Current Cost

8. Progress in Addressing the Barriers to Smart Metering

The most important issues that prevent the general introduction of smart metering within the EU and outside Europe are:

- There is still much uncertainty about the quantification of benefits as practical experience and historical data are lacking.
- There are many parties involved, and the benefits of smart metering may accrue to other parties than the ones that bear the costs.
- In a big scale, roll out of smart metering is a very long and costly process, requiring considerable capital expenditures from the responsible market actors while in many EU countries, there is a big opposition from regulators to increase the tariffs to final users to pay for it.
- There is no interoperability between different owner's assets: no open registered standard exists which properly scopes the different functions (metering, communications, presentation, and network). The lack of adequate common requirements on functionality and open interfaces (interoperability) fractionalizes the market and increases costs both for smart metering and for the applications and services that use metered data.
- There is also a lack of modularity and lack of flexibility of present mass smart metering so special needs regarding distributed generation, demand response, power quality, customer information, energy efficiency automation and services, etc. can only be meet with high extra costs.

8.1. Law and "Lack of Law" barriers

Smart metering initiatives come mostly from governments so the future of smart metering will depend heavily on the policy and decisiveness of the governmental bodies involved. Smart Metering implementation is a very long and costly process, requiring considerable capital expenditures from the responsible market actors that need clear policy decisions from government and regulatory certainty regarding key concerns, so as not to deter investment.

The choice of regulatory policies to promote smart metering depends not only on the national legal framework and on the stage of market liberalization but also on the public or industry drivers for smart metering. The type of metering regime (regulated or liberalized) as well as the ownership of the meters can influence the benefits realized from smart metering and their cost effectiveness as an investment.

Roll out obligations are a starting to be an employed instrument and they are usually combined with specific regulatory tools covering technical, functional and economical aspects. But in some other cases current regulatory imperfections lead to inefficiency and distort a fair cost-benefit analysis of smart metering. For example, in most of the EU countries there is no time of use tariffs so there is no incentive for final customers to reduce demand at peak times.

Another example of "law barrier" is that in some countries the network operator revenues increase with electricity consumption discouraging them to adopt any measure that reduce final customer electricity consumption.

8.2. Economical barriers

There are economical barriers that hamper the introduction of smart metering:

- There is still much uncertainty about the quantification of benefits as practical experience and historical data are lacking.
- There are many parties involved, and the benefits of smart metering may accrue to other parties than the ones that bear the costs several market actors are expected to have direct or indirect benefits from mandatory implementation of Smart Metering but they will not share the costs and benefits: capital and installation costs are normally solely covered by a local DSO (metering is controlled by Energy Suppliers companies ONLY in UK) which is responsible for the metering but perceive only partial benefit while many benefits go to the RESC but they cannot influence the design of the system.
- In a big scale, smart meter roll out is a very long and costly process, requiring considerable capital expenditures from the responsible market actors while in many EU countries, there is a big opposition from regulators to increase the tariffs to final users to pay for it.
- There is no expectation of obtaining grant aid or subsidies from the governments to install smart metering in many of the EU countries.
- High investment costs expose the responsible actor to considerable financial risks both during the implementation, commissioning and regular operation period, so such a big investment requires at least to be sanctioned by governments to prevent short sighted and unpredictable regulation in the future.
- Smart metering also entails an organizational challenge. The purchase and commissioning of Smart Metering equipment requires involvement of highly-skilled personnel. This is often a problem for small- and medium-size market actors, which do not have sufficient technical expertise for the initial procurement process.

Additionally there are several cost-driving activities during installation of the equipment, related to logistics and working crews.

- Shorter life time of electronic meters in comparison with electromechanical meters reduces the return of investment of a smart metering implementation.

8.3. Technical barriers

There are also technical barriers that stop the implementation of smart metering in a large scale:

Although there are some commercial systems capable of supporting AMI, there is an important lack of interoperability among these systems, which prevents the large scale adoption of the smart multi metering technology. So, the main problem for the large adoption of AMI, is the lack of a set of widely accepted open standards capable of guaranteeing the interoperability of systems and devices produced by different manufacturers. The lack of adequate common requirements on functionality and open interfaces (interoperability) fractionalizes the market and increases costs both for smart metering and for the applications and services that use metered data.

There is also a lack of modularity and lack of flexibility of present mass smart metering so special needs regarding distributed generation, demand response, power quality, customer information, energy efficiency automation and services, etc. will only be meet with extra high costs.

A large scale roll out of AMR/AMM without adequate requirements and standardization may prevent the development of services and applications that are based on smart metering infrastructure until it is time for the next roll out after 10 years or so. On the other hand poorly designed standardization can prevent development and innovation.

There is also a weak cooperation between DOSs/RESCs and AMR equipment manufacturers: joint efforts, common approach and consensus, especially on AMR technologies and data transmission, could speed up development of smart metering. Also important in this context seems to be an issue of integration of measuring all grid mediums delivered to the consumers (electricity, heat/cool, natural gas, water, sewage) in one data transmission device/unit and additionally serviced by one operator. Integration of much more parties could support development of Smart Metering.

Installation of Smart Metering requires skilled manpower to replace the meters. If the implementation period is short or/and several DSOs are running the process simultaneously, it may create serious problems due to limited access to local manpower.

Furthermore, when a single country implements a mandatory requirement for implementation of Smart Metering within a relatively short time period, it may easily create a shortage of the Smart Metering equipment on the market and cause unnecessary complications for the process.

Several potential risk factors are caused by the present situation in production of Smart Metering equipment. It is a fairly small industry, which is still growing and evolving, with few well-established and renowned vendors and several middle-sized and small ones. During the last years there have been several bankruptcies, mergers and takeovers in this sector. In some cases it resulted to discontinuation of supplies and support to already installed equipment. Several utilities share a concern that it is difficult to find reliable and competent suppliers of equipment, especially when it comes to small utilities, which do not have as strong bargaining position as big ones. There are several examples of big utilities purchasing a share in Smart Metering vendor companies in order to secure their projects.

8.4. Awareness and knowledge related barriers (on society level)

Another potential risk to hamper the introduction of smart metering is the negative customer reaction due to different factors:

- Customers may be unaware of smart metering initiative.
- Customers may be concerned about privacy of data and will refuse to participate to show disagreement with the initiative.
- Customers may consider smart metering implementation as a way to increase their bills.
- Customer's rejection will appear if after the implementation the expected benefits do not materialize.
- Customers may not be satisfied with the implementation plan.
- Customers do not understand rate structure and think that smart metering will not help them to reduce their energy bills.
- Customers think that they cannot decrease their energy consumption without compromising their living standard.

To mitigate this potential risks, it is necessary to establish a careful and properly orchestrated communication and education plan to final customers and a well thought out installation process, clearly communicated to customers to minimize their inconvenience during the installation phase.

9. Conclusions

This report has reviewed the development of smart metering in Europe. The key finds are that there are many implementations of smart metering underway across Europe. Most of these are trials or pilot projects and many are assessing the impact of smart metering on consumer behavior. These trials have yet to provide the evidence needed to allow a conclusive view on the levels of energy savings that smart metering can provide.

Smart metering technology has shown general evidence of product evolution, although this is limited by the lack of agreed functionalities preventing mature smart meters to be produced. There has been significant progress in feedback displays, some with their own power transducers and many linked to smart metering. There has also been significant progress with web feedback platforms. Also of note has been the growing range of devices that link to open protocol home area networks. As well creating the possibility of very large markets that will bring down prices, this provides a route from the smart metering Wide Area Network through to HAN equipped appliances and controllers.

Driven largely by Article 13 of the Energy Services Directive and an environmental agenda, a significant number of European Member States have taken major steps towards a full roll out of residential smart metering. This has thrown up into greater relief major barriers around the implementation of smart metering. These include possible conflict with the MID, a lack of standards supporting the full range smart metering functionalities, the mis-alignment between those who pay for smart metering and those who receive the benefits and a lack of experience and firm evidence for costs and benefits.

10. Appendices

Appendix 1

Activities of RWE on the field of smart metering pilot projects in Germany

German utility RWE will be equipping 100,000 households in Mülheim in Ruhr region with smart electricity meters. This project represents the first area-wide deployment of smart meters in the country and was going to be started in 2007.

The new meters would provide customers with more comprehensive and up-to-date information about their energy consumption in future. Total cost of this pilot phase was estimated on some 20 million € for three years of implementation period.

With a project of this magnitude, RWE has the opportunity together with the electricity meter manufacturers to take a decisive step forward in the development of this technology. RWE is working on increasing cost transparency for the customer. RWE wants to give the customer a tool with which they can check their energy consumption in order to effectively save on energy and therefore money.

RWE Energy is pursuing two main objectives with testing the smart meters. The company is increasing cost transparency for customers, thereby strengthening their trust in the energy market, and also addressing the need for energy efficiency. A change in consumption behaviour will only occur when customers can directly check the success of their energy saving measures.

The aim of RWE is to develop a smart meter with an open standard which can function with all common billing programs and also integrate gas and water meters. This technology offers the potential for new tariff models that reward and support energy-saving behaviour, such as time of day or weekend tariffs.

The city of Mülheim hosts the pilot project. With around 170,000 inhabitants and 100,000 electricity connections, the city is exactly the right size. Through its mixture of densely and less densely built-up areas, it provides the opportunity to test several data transmission technologies simultaneously.

RWE Rhein-Ruhr AG, responsible for the conceptual design and implementation, will be supporting the “100,000 smart meters for Mülheim” project on location through communication. To start with important public buildings such as schools or administrative offices will be equipped with the new devices, which will allow residents to learn about the new technology. The final implementation is the responsibility of the unbundled grid operator RWE Rhein-Ruhr Verteilnetz GmbH.

Appendix 2

List of identified Smart Metering projects

Ref	Utility	Country	No of meters	Energy streams	Vendors	Start date	End date	Comments
				Europe				
**	Energie AG	AT	10 000	e	--	2007	2008	Trial
	Feldkirch	AT	3 000	e	Echelon	--	--	Trial
	Linz Strom	AT	75 000	e	--	--	--	Trial
	Cez	CZ	400	e	Echelon	2008	2008	Trial
	E.ON Czech Republic	CZ	4 000	e	--	2006	--	Trial
	EnBW	DE	1 000	e	--	--	--	Trial - ongoing
	EWE	DE	400	e	--	2008	2009	Trial
**	Mulheim an der Ruhr	DE	--	e	--	2008	2010	Trial
	RWE Mulhiem	DE	100 000	e	--	2008	--	Trial, cost of €20m
	Stadtwerk Duesseldorf	DE	1 000	e	L+G	2008		Trial
	Stadtwerk Hassfurt	DE	10 000	e	Echelon	2008	2011	Trial
	Stadtwerke Bochum & EVB	DE	500	e	Echelon	2008	--	Trial
	TWK Kaiserslautern & EVB	DE	1 000	e	Echelon	2007	--	Trial
	Yello Strom	DE	1 000	e	--	--	2008	Trial
	Elro Net	DK	50 000	e	Echelon	2007	2010	
	EnergiMIDT	DK	170 000	e	Echelon	2008	2010	
	NRGI	DK	52 000	e	Echelon	2008	2011	

Ref	Utility	Country	No of meters	Energy streams	Vendors	Start date	End date	Comments
	Odense Energi	DK	72 000	e	L+G	--	2009	
	SEAS-NVE	DK	390 000	e	Echelon, Gorlitz	2008	2011	Use M-Bus link to legacy gas, water, heat meters
	Syd Energi	DK	250 000	e	L+G	2004	2008	
	TRE-For	DK	200 000	e,h,w	L+G	--	--	
	Empresa Electrica Quito	EC	700 000	e	--	2007	2009	BPL focus
	Fortum Espoo Oy	FI	63 000	e	L+G	--	2007	
	Haukiputaa Electricity Cooperative	FI	9 000	e	L+G	2008	2011	
	Helsinki Energy	FI	120 000	e	Aidon Oy	2008	2010	
	Jyvaskylan Energia	FI	4 000	h	L+G	--	--	
	Kainuun Energia	FI	55 000	e	L+G	--	2008	
	Kemin Energia	FI	15 000	e	--	--	--	
	Satapirkan Sähkö Oy	FI	70 000	e	L+G	2008	2012	
	Tampere City Electric Works	FI	4 700	e,h	L+G	2008	2010	Electricity metering - , April 2008 about 25 000 customers have AMR, all 100 000 customers will have AMR by the end of 2010. Customers have internet access to their own consumption measurement data. Heat metering - may be more meters
	Tornion Energia	FI	11 000	e	L+G	2008	--	replacing old meters at end of their life
	ERDF	FR	30 000	e	L+G	2010	--	trial - leadign to 35m meters, L+G have 33% of meter sales
	ESB	IR	21 000	e	Sagem,Elster, Trilliant, Aclara	2008	2010	Trial, expected to do all homes for €4b - 1.8m homes

Ref	Utility	Country	No of meters	Energy streams	Vendors	Start date	End date	Comments
	Acea Distribuzione	IT	1 500 000	e	L+G	--	2009	
	Oxxio	Ne	100,000	e		2006	--	Rolling out to all customers
	Kragero Energi	NO	8 600	e	L+G	2007	--	
Sweden is undertaking a full roll out of AMR and there are numerous projects; those shown below have been reported in the pres but do not constitute a comprehensive list								
	E.ON Sverige	SE	390 000	e	Echelon	2007	2009	
	Fortum Espoo Oy	SE	900 000	e	L+G	--	2008	Full AMR implementation, Fortum has nearly 600 000 distribution customers in Finland and is planning to start full AMM implementation soon.
	Goteborg Energi AB, Lerum Energi AB	SE	100 000	e	Kamstrup		2009	well over 100,000 meters for €6.6m
	Gothenburg Energy	SE	270 000	e	Nuri	--	--	
	Halmstad Energi	SE	38 000	e	Echelon	2007	2009	Also SCADA system
	PiteEnergi	SE	20 000	e	L+G	--	2007	
	Staffanstop Energi AB	SE	6 000	e	L+G	--	2008	
	Vaxjo Energi AB (VEAB)	SE	20 000	e	Logica	--	2008	web based portal
	Vattenfall Distribution	SE	900,000	E	Several	--	2008	Also in Finland 360,000 Iskra meters
	Elektrovojvodina D.O.O.	Serbia	30 000	e	--	2007	2010	
**	Opus Energy	UK	--	--	--	--	--	£5m programme
**	Orsis	UK	--	e,g	--	--	--	
	UK Energy Demand Reduction Project	UK	--	e,g	various	2007	2010	Trial

Ref	Utility	Country	No of meters	Energy streams	Vendors	Start date	End date	Comments
				Americas				
	BC Hydro	CA	1 900 000	e	--	--	--	start of procurement process
	Consumers Energy	CA	3 500 000	e,g	--	2008	2014	1.8m e, 1.7g add on comms
	Enersource Hydro Mississauga	CA	185 000	e	Elster	2007	2010	
	Horizon Utilities	CA	231 000	e	Elster	2007	2010	
	Hydro One, Hydro One Brampton, Milton Hydro Distribution	CA	350 000	e	Trilliant, L+G	2006	--	6.5% demand reduction in trial
	Hydro Ottawa	CA	230 000	e	--	2006	2008	
	Manitoba Hydro	CA	750 000	e,g	Itron	2008	--	
	Peterborough Distribution	CA	35 000	e	--	--	2010	
	PowerStream	CA	237 000	e	Sensus	2006	--	
	Toronto Hydro-Electric System Limited	CA	680 000	e	--	2007	2009	
	Alliant Energy	US	626 000	e,g	Sensus	2008	--	450000e, 176000g
	Ameren Illinois Utilities	US	1 100 000	e	L+G	2006	2008	Aiming for 1.1m - linked to scada system
	American Electric Power	US	5 000 000	e	--	2008	2015	
	Arizona Public Service	US	800 000	e	Elster	--	--	
	Arizona Public Service	US	800 000	e	--	2006	2013	
	Atlantic City Electric	US	500 000	e	--	2008	2013	
	Austin Energy	US	234 000	e	Cellnet	2002	2008	
	Burbank Water and Power	US	45 000	e	--	--	--	
	Central Vermont Public Service	US	152 000	e	--	2011	2013	
	Centrepoint Energy	US	3 000 000	e,g	Itron	2008	2014	5 years upgrading AMR to AMI

Ref	Utility	Country	No of meters	Energy streams	Vendors	Start date	End date	Comments
	Clarksville Department of Energy	US	54 000	e	muNet	--	--	
	Commonwealth Edison	US	120 000	e	--	2008	2013	Trial
	Cumberland Maryland	US	11 000	w	Sensus	--	--	
	Delmara Power	US	300 000	e,g	--	2009	--	aiming for 500,000 electric and 121,000 gas meters
	DTE Energy	US	2 700 000	e,g	Itron	2009	2012	Pilot
	Duke Energy (Kentucky)	US	21 000	e,g	--	--	--	120000 e. 90000 g
	EPB	US	500 000	e	--	2008	2012	
	Florida Power & Light	US	4 500 000	e	--	2008	--	
	Georgia Power	US	2 000 000	e	Itron	2007	2012	
	Iowa Exercises	US	1 400 000	e,g	--	--	--	
	Modesto irrigation District	US	112 000	e	L+G	--	--	
	Pacific Gas and Electric	US	5 000 000	e,g	GE, L+G	2007	2012	Not signed yet, $1.7b for whole programme, $450m for meters, 10,000 - 12,000 meter install per day 5.1 million electricity 4.2 million gas meter
	Portland General Electric Co.	US	850 000	e	Sensus	2008	2010	
	Potomac Electric Power Co	US	256 000	e	--	2008	--	Proposal, moving to ami for all 1.8m customers
	Progress Energy	US	2 700 000	e	Itron	--	--	AMR only
	Public Service Electric and Gas Company	US	32 500	e	--	2008	--	trial
	Salt River Project	US	--	e,w--	Elster	--	--	
	San Diego Gas and Electric	US	2 300 000	e,g	Itron	2009	2011	waiting for approval from Californian Public Utilities Commission 1.4m e, 0.9m gas amr modules

Ref	Utility	Country	No of meters	Energy streams	Vendors	Start date	End date	Comments
	Southern California Edison	US	5 300 000	e	Itron	2009	2011	$480m for comms plus 80% of meters
	Southern Company	US	4 300 000	e	Sensus	--	--	
	Sulphur Springs Valley Electric	US	30 000	e	Cellnet	--	2010	
	Tallahassee	US	220 000	e,g,w	Elster	2007	2010	110,000e, 25,000g add ons, 85000w
	Xcel Energy	US	100 000	e	--	2008	--	
	Oncor Electric Delivery Company	US	3 000 000	e	L+G	--	2012	Contract signed

Ref	Utility	Country	No of meters	Energy streams	Vendors	Start date	End date	Comments
				Rest of World				
	blacktown Solar City	AU	10 000	e	--	--	--	environmental initiative, total meters split across a number of projects
	Country Energy	AU	10 000	e,g	IBM	--	--	Trial
**	New South Wales	AU	--	e	--	2008	2018	announcement
	Victoria	AU	--	e	--	2010	2013	
	ELEKTROPRIVREDA HZ HB MOSTAR	BA	200	e	Echelon	--	--	Trial, aiming to move to 200000
	Grinpal Energy Management	IN	500 000	e		--	2010	
	Contact Energy	NZ	500 000	--	Vector, Siemens	2008	2013	
	Genesis Energy	NZ	600 000	e,g	Vector, Siemens	2008	2012	Contract signed with meter provider Vector NGCmetering
	Mercury Energy (Metrix) (Mighty River Power)	NZ	340 000	--	Elster		shortly	successful 5000 home trial
	Meridian Energy	NZ	200 000	e	Arc Innovations	2008	--	
	--	RU	375 000	e	Echelon, ECA	--	2008	$6800000 for 80,000
	Eskom	SA	120 000	e	--	2008	--	
	Trinidad and Tobago Electricity Commission	TT	400 000	e	Itron	2007	2009	AMR only
	United Arab Emirates	UAE	--	e	--	--	--	Based on energy efficiency
	Total Rest of World		3 055 200					

Ref	Utility	Country	No of meters	Energy streams	Vendors	Start date	End date	Comments
	Total worldwide		64 243 300					

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