



National perspectives on Smart Metering

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1. Introduction

This report is a delivery of the ESMA – European Smart Metering Alliance project. ESMA is a forum for exchange of balanced information about smart meters – with special focus on energy efficiency. Further information at www.esma-home.eu.

In the major parts of the ESMA project focus will be on general issues that are relevant in many European countries. However, in this memo we will complement this general approach with a special focus of national perspectives. As will be demonstrated in this memo national conditions exist that are very important for the implementation of smart meters. The national differences can e.g. stem from national traditions, national regulation or national company structure. The idea of describing these national differences is to improve the understanding of the condition for smart metering – and to show how the national perspective in one country can give a new perspective to the possibilities in another country. Also, understanding national differences can help understand the potential and barriers for EU wide harmonization and regulation.

The memo is delivery 5 from work package 2: Review of Smart Metering Experience. The implementation of Smart Metering across Europe will be reviewed. The study will make a comparative analysis of regulation and market conditions in Europe. There are many links from this task to other deliveries, e.g. delivery 7 and 9. The deliverables are:

- D2: Impact Analysis on European Metering Industry Stakeholders
- D3: Definition of Smart Metering and Applications and Identification of Benefits
- D4: Report on Innovative Customer Energy Products
- D5: Review and Consolidation of Smart Metering Experience
- D6: Report on Effective Customer Feedback Mechanisms
- D7: Report on Regulation and European Market Conditions Related to Smart Metering
- D8: Report on Methodology for estimating Energy Savings related to Smart Metering
- D9: Report on Barriers and Drivers and Recommendation for Action

In ESMA the definition for smart metering is:

Smart metering has the following features:

- Automatic processing, transfer, management and utilisation of metering data
- Automatic management of meters
- 2-way data communication with meters
- Provides meaningful and timely consumption information to the relevant actors 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)

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2. National perspectives in a global world

Many issues relevant for smart meters are European or even global, e.g. technological development in meters and communication systems. Other important issues like general trend in energy markets, energy regulation and market structure exist in several flavours – European, American and other areas.

National differences include hard facts like size of population, energy consumption (by sector), type of energy supply (e.g. hydro, coal, nuclear, wind power, CHP). Also the structure of the supply sector as well as the structure of meter companies are important. Without doubt the size of Italian electricity company ENEL has been important for the massive roll out of AMR in Italy.

In many countries meters are supplied by grid companies acting as local monopolies, however in other countries the provision of meters has been liberalised and is supplied by commercial companies. In Great Britain meters are managed by three types of organisations: Meter asset providers, Meter operators and Data collectors. In Germany liberalisation of the meter business is under way.

National energy taxes can influence the economic consequence of metering. E.g. in Denmark a high tax on water is part of the reason why all households have an individual water meter. In some countries environment is high on the agenda, in others not. In some countries non-technical losses are high, in others not.

Maybe the strongest contribution to national differences is the political discourse in each country. A history and tradition exist in all countries which influences how energy policy is discussed and which issues have top priority. In some countries energy poverty is an issue, in others not. In some countries the opposition against “big brother” surveillance is strong, in others not. Such political differences may reflect the hard facts mentioned above or a specific historical background.

The status concerning meters is varies a lot among the European countries. In some countries individual meters for all households are still under way, while advanced meter systems are wide-

spread in other countries. Several countries are in the process of implementing new meters. Not all new meters are smart meters as defined in this project. E.g. in Sweden the requirements from the regulator are that all meters should be read once per month. This is possible to fulfil by manual reading, but many utilities invest in advanced meters, nevertheless.

3. Examples of national perspectives

In this section we will illustrate the importance of national perspective on smart metering for households. Only a limited number of countries are covered. The focus is on national perspectives with emphasis on economical, cultural and political issues that are important for understanding the discussion about smart metering. The understanding of national characteristics may be helpful finding issues ready for EU wide harmonisation.

As from July 2007 all EU households can choose their supplier of electricity.

The development in relation to smart meters is expected to continue. This text is updated as per primo 2008.

3.1. Great Britain

Typically meter readings are done every 3 month by inspectors. Between 27% and 55% of bills sent out by Suppliers are estimated. Also, prepaid meters are wide spread. 14% of households buy electricity though prepaid meters and 10.4% of gas customers.

Discussion about smart metering in UK is mainly fuelled by interest in saving energy in addition to the interest of RESCs in improving customer service. Energy efficiency is largely related to feedback of energy consumption by the use of displays. Pilot projects with 40,000 households have been initiated to document the energy savings benefit of displays. This project will examine a wide range of feedback routes, including in-house display and bills.

Since the late 1990's management of the meters in the electricity sector has been liberalised into Meter asset providers, Meter operators and Data collectors. These functions can be supplied by independent companies, but often the 6 largest suppliers (RECS) have their own meter business. The 6 suppliers deliver 99% of all electricity in the UK. Today the meter stock is very diverse with many different owners and meter types in any district. The organisation of the meter business is influenced by strong viewpoints from the regulator (OFGEM) in favour of competition. Wherever possible, OFGEM seeks to minimize regulation and promote market based solutions. For instance, OFGEM was requested by the UK Government to investigate smart metering interoperability. At the same time the Energy Retail Association (representing all the major UK RESCs)

launched a project developing a smart metering operational framework, and OFGEM has chosen to defer its responsibilities to ERA, as this is considered market based.

Retailers have since 2004 been obligated to work for energy efficiency. The requirements have been increased in several steps and from 2005-2008 the retailers were required to realise savings corresponding to 130 TWh.

RECS is now allowed to enter contracts for a longer period with consumers. An earlier 28 day rules was lifted in 2007. A rule of mandatory inspection of meters every second year has also been relaxed, subject to approval on safety grounds. Both issues had an obstacle to investments in new meter systems.

There is a strong public and media resistance against unjustified surveillance (big brother) and the understanding is that the use of demand profiles will continue for households even after investment in smart meters.

Energy poverty is an important issue in the UK.

The Government has committed itself to smart meters being widely installed within 10 years. In its 2007 Energy White Paper it calls for customer displays should be provided to all who request them and whenever meters are replaced.

Status for smart meters	Active debate, large pilot projects
Main driver for smart meters	Energy efficiency
Current meter practise	1 reading per 3 months by inspectors
Governments position	2016 goal
Regulator position	Focus on protecting consumers against extra cost
Electricity sector position	General agreement on desirability of smart metering but requesting government mandate for this to overcome UK specific barriers.-
Other energy sector position	-
Existence of energy poverty and/or pre paid meters	14% electric pre paid meters and 10.4% gas Political focus on energy poverty
Other policy of relevance for smart meters	Obligation to retailers to promote energy efficiency and renewables

3.2. The Netherlands

In September 2007, the Dutch Council of Ministers agreed on a proposal of the Minister of Economic Affairs to change the national Electricity and Gas law in order to improve the functioning of

the liberalized energy market for consumers. This bill also gives shape to the European ESD-Directive. The introductions of a new market model in combination with a 100% roll out of smart metering are key issues in this bill. If the bill passes Dutch parliament, to be expected during 2008, it will turn into formal legislation and result in smart metering being made available by the end of 2014 to all the 7 million Dutch households and small business users.

Although the EU Energy Efficiency Directive is a starting point, there are other reasons for a complete roll out to all users. First, the Dutch government considers smart metering as an incentive to optimise the working of the liberated energy market by improving administrative processes and taking advantage of all the potential benefits for energy efficiency. Smart metering is believed to be an important element in facilitating competition. This covers a second reason for legislation: In a liberalised market, without further regulation, a smart metering roll out would probably reach no more than about 30% penetration. This has to do with the issue of split incentives, and the fact that in an unregulated market the chance that a meter contract will be lost to a competitor is an important factor in the attractiveness of the business case. In the case of a partial penetration, several of the smart meter benefits would not be realised, because for some of the benefits to be materialised a 100% roll-out is a prerequisite. An important reason in other countries, limiting customer peak load demand to reduce the size of maximum demands in capacity e.g. on hot summer days, is a less important driver for The Netherlands. On the other hand, a shifting of peak demand to other parts of the day in order to stimulate more efficient production and base-load is regarded as an important potential benefit to the overall system.

The approach in The Netherlands can best be described as an open platform: the grid operators on the one hand, of which there are four main operators, will own and maintain the smart meter and be responsible for a total distribution. In the case of new connections, new builds and other changes, such as end of lifetime or meter pooling, the installation of smart meters by the grid operators will be compulsory. On the other hand, the energy retailers will be responsible for all customer related processes and the management of the metering data.

Another key aspect of the proposed roll out is that grid operators, energy retailers, service and communication providers have agreed about the interoperability and compatibility between systems. Therefore a single technical standard (NTA 8130) has been developed through the Netherlands Standardisation Institute. Important elements among others are the communication protocol for the various interfaces of the smart meter, the minimal functionalities required, an open access portal to the meter and a minimal level of metering data which the meter should generate.

The total costs of a 100% smart meter rollout across The Netherlands is estimated to be between €1.1 and €1.5 billion, with a return of €800 million to €1.2 billion. However it should be possible to

fund the project at least partly from the current meter tariff. This tariff should remain unchanged or even decrease. To date the meter charge has not been regulated and has increased by up to 100% since 2001. The Dutch Competition Authority has stated that it does not believe that there is a relation between the increased tariffs and the actual costs. These costs will now be regulated, while the data collection costs, which will be set by the supplier, will be unregulated. It is important that commercial parties are absolutely free to do more and to differentiate themselves from competitors in terms of the aggregation and frequency of data and added value services (benchmarks, savings advice).

From an energy saving perspective, the Dutch the government is taking a conservative approach with a projected 2% saving per annum. However, evidence shows that real savings can be higher. Therefore the Dutch expect that this 2% will increase over time, when smart metering gains more interest, and is coupled with other energy saving options. But a lot depends on the customers and how willing they are to change their attitudes to energy usage. In terms of the proposed regulatory framework energy consumption data will be provided to customers at least six times per year, this being believed to be frequent enough for customers to be able to undertake their own energy management. One of the most important reasons for the 'open platform' approach is that the potential for energy savings in the built environment is as strongly facilitated as is possible. The market should be able to solve the problem that actual savings depend on customer behaviour, and create other solutions such as automatic energy management within the individual home.

Data is expected to be provided in graphical form and for comparison purposes, such as the usage over a similar period of say a year ago. Data is also expected to be provided in both kWh's and Euros, so that it can be understood by the customers who don't have a technical background. But this is left to the suppliers, who better understand their customers. The technical requirements of the smart meter specifically list that the provision on or through the meter of euro-values should be possible.

There are already several pilot projects under way, with approx. 100.000 smart meters currently in use in The Netherlands. However, most pilots are meant to test the technical aspects of a massive roll out. Massive and structured roll-out is expected to start towards the end of 2008 when the legislation is in place. Consumer behaviour related figures are scarce, also because these are considered to be commercially sensitive data.

Status for smart meters	In 2007 the Dutch Government agreed on a proposal to introduce smart meters by the end of 2014. Active debate; consumer bodies are reserved. Large private pilot projects coming up.
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Main driver for smart meters	Optimizing liberalisation energy market, consumer benefits (accurate billing etc), energy efficiency
Current meter practise	Manual reading once per year by self reading
Governments position	100% roll out is required for maximum effect all drivers combined, roll out complete in 2014.
Regulator position	Grid operators (independent, non commercial) roll out and maintain all smart meters, interoperability and compatibility through development technical standards
Electricity sector position	-
Other energy sector position	-
Existence of energy poverty and/or pre paid meters	Pre paid meters: not common, few pilots local pilots for debt reduction. No political focus on energy poverty.
Other policy of relevance for smart meters	New market model for private consumers; The National plan 'New Energy for Climate Policy' containing the Clean and Efficient programme. This programme describes how the Netherlands is aiming to have one of the most efficient and cleanest energy systems in Europe by the year 2020.

3.3. Spain

Since January 1998, Spain has had a new regulating framework which is the basis of a new electrical system. This new system is based on the implantation of liberalization and competition criteria, which must be compatible with the conservation of the environment and the security of the supply. Its primary target is to promote free initiative of the agents who operate in the system with the purpose of increasing the quality of service and the competitiveness of the Spanish electrical prices.

The new system is based on the Law of the Electrical Sector (Law 54/97) approved by the Spanish Parliament in November of 1997 as well as on the Decrees that develop it. At the same time, this set of new legal norms is based on: The European Union Directive about the Electricity Inner Market and the Protocol for Regulation in the National Electrical System.

Before the Electrical Sector Law of 1997 the majority of meters installed in Spain were induction meters.

With the complementary technical instructions to this law and the liberalization of the market, utilities were forced to change their high voltage meters (industrial consumers in high voltage) by meters with an AMR system with hour load profile. Since 2002 nearly 40.000 new meters have been installed.

Introduction of AMM Systems to residential customers is assumed by the government as an opportunity to establish different tariffs in the different periods so the consumer can adapt his consumption to low cost periods helping the system to reduce peak demands. The law was last changed August 2007.

The new classification means that about 100.000 equipments more must have an AMR system. This system will be the responsibility of the utility but, until today, economic aids for the system implementation has yet to be defined.

In addition, it implies the installation of a Smart Metering system for the domestic meters which requires the change of 98% of meters (almost 22.000.000 of them). On the Minister of Industry Order ITC/3860/2007 of 28th of December 2007 the Government defined the terms to execute the change of meters: By end of 2010: 30% of the domestic meters, by end of 2012: 50%, by end of 2015: 70% and by the end of 2018: All domestic meters.

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

Expected benefits for customers from Smart Metering System:

- More alternatives at tariff selection, adapted to the regular customers consumption, more energy and costs savings.
- Exact reading and billing, on time and without errors, fewer complaints to the supplier.
- Better attention to the customer due to better availability of information.
- Customers involvement is not needed, due to remote operation
- Immediately adding and cancelling contracts, no waiting time.

Benefits for the electrical system:

- Smart metering will contribute to a better management of peaks demand.

- Better power control due to the cut off “*intelligent*” function.
- More information about the grid’s state and behavior, better planning and development.
- Better fraud detection: looses reductions.
- More flexibility at facing regulation changes.
- More efficiency and quality for customer technical operations.
- New model of relationship with costumers, bidirectional communication.

Status for smart meters	In 2007 the Spanish Government agreed on a proposal to introduce smart meters starting at 2008 and to be end at the end of 2018. Large private pilot projects coming up.
Main driver for smart meters	More alternatives at tariff selection, adapted to the regular customers consumption, more energy and costs savings.
Current meter practise	Manual reading 6 times per year by external companies contracted by DNOs
Governments position	100% roll out is required for maximum effect all drivers combined, roll out complete in 2018.
Regulator position	Focus on interoperability and compatibility through development technical standards
Electricity sector position	Extra costs should be assumed by the system as a hole and not only by DNOs
Other energy sector position	-
Existence of energy poverty and/or pre paid meters	Pre paid meters: not common. No political focus on energy poverty.
Other policy of relevance for smart meters	-

3.4. Portugal

In 2001 the Portuguese Government published a resolution with several energy efficiency measures, and described the objective to “support the progressive implementation of telemetering for electricity, water and gas as a strategy for distribution network and quality service improvement”. Also during 2001 the Portuguese and the Spanish Governments took the first steps towards the Electricity Iberian Liberalised Market (MIBEL) where both Portuguese and Spanish consumers could buy electricity freely from any agent in the market. Technical agreements specified by MIBEL include: the compulsory installation of digital meters for new facilities since July 2007 and also the replacement of all traditional meters (6 million in Portugal) by telemeters. This represents an enormous cost and political negotiations are still in course to clarify who will pay for the equipment’s substitution. In 2002 the National Energy Regulator Entity (ERSE) was created for electricity and natural gas market regulation. Telemetering was not, however, a much discussed topic in the following years.

In October 2007, a public consultation on the replacement plan and minimal required functionalities of traditional meters has been issued by ERSE for the Domestic and SME consumers (low voltage consumers - with contracted electricity power up to 41,4 kVA). This has finally brought into the highlight the national debate on Telemetering, involving all interested parts in the discussion.

Following the public consultation, a proposal was presented to the Portuguese Government, suggesting a pilot project in order to validate the different scenarios' presupposed, especially the considerations on benefits arising from behavioural changes. The cost of this pilot project is expected to be 2 M€ and to involve 7.500 low voltage consumers. Different forms of feedback to the consumer shall be tested in order to evaluate the impact and influence in their consumption behaviour. The most polemical point in the Regulator's position was the defence of direct reflection of the meters replacement costs in the energy tariffs of the final consumer (about 3,1% increase). The Government's final position is not yet known.

Apart from this consultation, some pilot projects are already in action, promoted mainly by the energy sector and NGOs, in order to provide representative inputs to estimate energy savings and smart metering cost-benefit analysis.

Status for smart meters	Active debate: public consultation on meters replacement promoted by the Regulator for Domestic and SME consumers. Pilot projects promoting multi-utility smart meters implementation take place.
Main driver for smart meters	Energy efficiency, market competition, multi tariff offer.
Current meter practise	Manual reading with 6 month interval
Governments position	Traditional meters mass replacement (6 million); digital meters in new facilities since July 2007.
Regulator position	Defends that the meters replacement costs should be reflected in the energy tariffs, affecting mainly the final consumer (about 3,1% increase).
Electricity sector position	--
Other energy sector position	Natural Gas sector enterprises do not see many advantages in multi utility meters.
Existence of energy poverty and/or pre paid meters	Pre paid meters not common; No political focus on energy poverty.
Other policy of relevance for smart meters	--

3.5. Latvia

The deregulation process was started after adoption of the Electricity Market Law in 2005. Until now there has been little competition in the market and very few end-users have changed supplier of electricity.

The significance and interest of Latvenergo in electronic metering has lately increased for the following reasons:

- Increasing interest in providing different tariffs for peak hours and night time or more articulated and customer designed tariff systems.
- Having a better fraud detection possibilities, in particular in rural areas where there are still many illegal consumers
- Increasing metering accuracy, in particular when replacing very old electromechanical meters, which are inaccurate at low consumption level.
- Reduction of costs for metering and billing with the implementation of AMR

Currently in Latvia there is not a high interest from the utilities to provide feedback to consumer. All households have a flat tariff. Meter reading takes place every month often by self-reading and can be returned by Internet, SMS, E-mail or fax. Twice per year the meters are read by inspectors. Payment can be directly charged to the bank account of the private customer.

Public Utilities Commission (PUC) is an independent state institution responsible for regulation of energy, telecommunications, post and railway sectors. However the PUC is currently not active in the field of smart metering. Smart metering is not seen as a way to promote energy savings.

Status for smart meters	Little interest
Main driver for smart meters	-
Current meter practise	Manual reading each month, inspectors twice a year
Governments position	Passive
Regulator position	Passive
Electricity sector position	Passive
Other energy sector position	-
Existence of energy poverty and/or pre paid meters	
Other policy of relevance for smart meters	

3.6. Czech Republic

Ripple control is widely used to switch on, off or change of circuit controlling of tariffs or electric load. 8 profiles are used for households. Two distribution companies are working to launch AMM pilot projects in Bohemia with approx. 5000 electrometers.

Status for smart meters	Little interest
Main driver for smart meters	-
Current meter practise	One reading per year
Governments position	Passive
Regulator position	Passive
Electricity sector position	Passive
Other energy sector position	-
Existence of energy poverty and/or pre paid meters	
Other policy of relevance for smart meters	

3.7. Denmark

Seven Danish distribution companies (out of 70) are currently working to implement interval meters. The new meters are able to collect data per hour, but are typically planned to be read monthly. The number of smart meters corresponds to 22% of all meters in Denmark.

Several utilities have studied how to implement smart meters. This includes the largest grid company, DONG Energy with 900,000 customers. A plan of a total renewal of the meters was delayed. The company found that the tariff regulation did not leave room for this investment. Now the utility has decided a slower roll out, focussing on customers with special needs.

In 2006 the Danish Energy Agency published a report about demand response. The TSO (Energinet.dk) participated in the working group that wrote the report. In this report interval meters were

analysed. It is concluded that if only demand response was to pay for new meters this would not be economically attractive. Also, a report from the TSO to the Energy Agency (in 2007) about the need for standardisation in relation to smart meters focuses on demand response.

The Danish Regulatory Authority has been passive in relation to interval meters.

The Government is negotiating with a supporting party and the opposition about a new Danish energy policy. Smart meters have been mentioned in the debate, e.g. by consortium of The Danish Consumer Council , Danish Wind Turbine Owners' Association, Danish Wind Power Association and Danish Energy Association (26. June 2007). The group suggests that grid companies should be allowed to increase tariff with up to 7 € per year (in 10 years) to cover the investment. Three center/left opposition parties have suggested that all customers should have AMR in 2012 (14. June 2007).

Status for smart meters	Some voluntary roll out (22%) Demand for smart meters part of the current political debate AMR is a few district heating
Main driver for smart meters	Focus on demand response
Current meter practise	One reading per year by self reading
Governments position	Negative (focus on costs)
Regulator position	Passive
Electricity sector position	Argue for regulation and cost sharing
Other energy sector position	-
Existence of energy poverty and/or pre paid meters	
Other policy of relevance for smart meters	

3.8. Finland

DSO arguments about smart meters include: improved efficiency of meter reading, better customer service by the DSO (regarding reclamations, outages, power quality, and customer connection), simplifying and harmonising ICT and business processes within DSOs that have merged several smaller DSOs, and the potential for improving the management of the electricity distribution grids. The arguments for smart metering by the Ministry of Trade and Industry are increasing demand elasticity to prices (demand response) and implementing the energy service directive. The main arguments by some electricity retailers include equal treatment of retailers in the small customer settlement, harmonising requirements and procedures between the Nordic countries and enabling demand response and load control based retail products. The system operator sees that small customer demand response will be increasingly needed as a resource for the system and for the electricity market. Energy end users, building automation providers, facility owners, facility management companies and energy analysis and service companies, and building auto-

mation companies all see that data from smart metering systems could help in analysis and improvement of energy efficiency; they see the poor availability, lack of direct data transfer from the meter to the end use energy management systems and high costs of timely data as big barriers. The DSO arguments have until now dominated the debate and most other needs may have been ignored in many AMR-implementations.

In 2006 a report examined the status of automatic meter reading of low voltage (0.4 kV) electricity consumers in Finland. The report is partially based on a questionnaire sent to the distribution companies. According to the survey about 47% of the billing meters would be read automatically in 2010 and about 61% in 2015. It is expected that the actual roll out will exceed these numbers, but full coverage will not be reached without new legislative push. The survey also revealed that the requirements set by the network companies for the metering systems and for the meters varied widely. For example, several DSOs may have implemented AMR systems that do not enable hourly reading for all the customers. Almost all new AMR-system orders in 2007 included hourly reading.

Time of use tariffs and time of use metering of electrically heated customers is very common in Finland. There are over 600,000 electrically heated household customers in Finland. (In addition, very many vacation houses have electrical heating.) Time of use metering has successfully levelled out the national load peaks. This and the developments of the electricity market and international transmission lines have very much reduced the regular price variations between day and night. The need for more flexible and situation dependent load control and demand response is increasing due to changes in generation (increase in unit size, possible increase in wind power, etc.) and high dependence on electricity import from transmission networks has rather high risk of internal congestions.

At the moment legislation requires settlement based on customer type load curves and prohibits settlement based on hourly measurement for small consumers. Hourly reading is not prohibited for the small consumers, but settlement based on measurements of hourly values is prohibited by the Electricity Market Act of December 2004. This aspect of the law was not well prepared and might be changed. The intention could have been to protect those utilities that were not able to manage hourly metered data cost efficiently enough with their existing systems. Compulsory load curve based settlement prevents all competition in the offering of demand response and load control based electricity products. If this barrier and also the cost related barriers could be removed, electrically heated houses could provide fast demand response increasingly needed in the local electricity market area.

Smart metering systems that include power quality monitoring in addition to load control and hourly metering are being further developed in Finland. As a consequence some DSOs now monitor power quality in all their feeders, permanently.

Status for smart meters	Considerable voluntary roll out (in 2007 in electricity 30% and in district heating 40% of metering points)
Main driver for smart meters	Improving DSO efficiency and customer service, The focus is expected to shift towards energy efficiency, demand response and harmonisation of the Nordic retail market.
Current meter practise	Hourly reading is required for all such customers that buy their electricity from competitive market and have a main fuse size over 3x63 A. Load profiles must be used for the settlement of smaller customers. Reading is required at least once a year with some exceptions. TOU-metering and tariffs must be offered by every DSO.
Governments position	Passive
Regulator position	Passive in electricity. There is no regulator for district heat and related AMR.
Electricity sector position	Legislation is necessary to achieve full AMR-coverage in Finland. Incentives are needed for DSOs to take into account the needs of the other actors. Sector organisation works to combine the divided views on requirements.
Other energy sector position	Electricity end users, ESCOs etc. are worried about the experienced worsening of the availability of metered data from the DSOs, regarding AMR for especially district heat but also for electricity.
Existence of energy poverty and/or pre paid meters	insignificantly small
Other policy of relevance for smart meters	-

3.9. Norway

From the 1st of January 2005 all metering points with a yearly consumption larger than 100.000 kWh are metered hourly. The DSO shall cover the costs for the installation of the technology, required for hourly metering of these customers. The DSO can also perform hourly metering (or other time resolutions for automatic meter reading) of additional metering points, if need be. According to the present regulation, the 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 situation the DSO can require that the final customer should cover the costs for installation of technology, limited upwards to 310 € (2500 NOK).

Full-scale mandatory implementation of Smart Metering was actively supported by the Norwegian Electricity Industry Association. During the last years several pilot projects in Norway studied feasibility of the Smart Metering and potential challenges related to its implementation. In the mean-

while more than ten utilities (mostly small DSOs) have done full-scale voluntary implementation of Smart Metering.

In June 2007 the Norwegian Water Resources and Energy Directorate (NVE) expressed their support to install so-called New Metering Technologies to all customers before 2013. The Oil and Energy Minister Odd Roger Enoksen supported installation of Smart Metering on the 21st of August 2007. NVE works on development of functional requirements for Smart Metering and the implementation schedule. So far the information about the expected functional requirements has not been made public. The overall expectation is that the NVE's requirements to the Smart Metering will be general, referring to the main functions of the meters. It is a possibility that the work will take longer than anticipated and the implementation requirements will be postponed accordingly.

Status for smart meters	Voluntary roll-outs, several large pilots
Main driver for smart meters	Reduction of costs for metering and settlement, accurate and timely billing, possibility for Demand Response schemes
Current meter practise	Customers with expected consumption over 8000 kWh pr year: at least quarterly, possibly each second month or monthly Customers with expected consumption over 100000 kWh pr year: mandatory hourly metering
Governments position	Active
Regulator position	Recommend general use of interval meters, at present studies the implementation schedule and the functional requirements
Electricity sector position	Active
Other energy sector position	-
Existence of energy poverty and/or pre paid meters	No
Other policy of relevance for smart meters	Any customer can require hourly metering, provided that he covers the expenses

3.10. Sweden

By July 2009 all electricity meters must be read monthly. For users above 63 A hourly reading is required.

It is not a requirement that meters must be read remotely, but most utilities are rolling out new meters with remote reading.

Part of the background for the regulation was media attention about late and incorrect electricity bills.

Status for smart meters	All meters must be read monthly by July 2009 Large investment in AMR
Main driver for smart meters	Accurate billing
Current meter practise	Roll-out is expected to be completed in time
Governments position	-
Regulator position	-
Electricity sector position	-
Other energy sector position	-
Existence of energy poverty and/or pre paid meters	No
Other policy of relevance for smart meters	-

3.11. Italy

ENEL has completed 30 million meter roll out. ENEL supply meters to 90% of the Italian end-users. ENEL highlight the following benefit of the system:

- Remote reading of energy consumption
- No more need for estimated billing
- Multi-tariff structure programmability
- Remote change of contractual parameters
- Remote connection/reconnection
- Capability of monitoring power supply
- Fraud detection and prevention

The decision about the total rollout of new meters was taken by ENEL. No regulation required this investment. ENEL indicate that the investment is profitable. Often households are supplied with electricity based on a tariff with a 3 kW maximum supply. If they wanted to change to a higher supply option an operator should visit the meter and make the changes. With the new advanced meter change of tariff can take place automatically.

Status for smart meters	AMR for 30 million consumers (our of x million)
Main driver for smart meters	Cost reduction related to kW-max tariff
Current meter practise	New meters are in operation
Governments position	-
Regulator position	-
Electricity sector position	Roll-out initiated by utility
Other energy sector position	-
Existence of energy poverty and/or pre paid meters	-
Other policy of relevance for smart meters	-

3.12. Poland

The detailed number of metering devices is not known, however it can be estimated on more that 15 millions of electricity meters, more than 1.5 million of heat meters and probably 5-6 millions

gas meters. It creates one of largest markets for development of smart metering, considering that only slight part of it is covered by such kind of meters. Only the largest industrial customers as well as partially public utility, services and commercial building are equipped with automatic meters which could be treated as smart ones after slight adjustments.

In housing sector meter readings are usually done at least two times a year by collectors and based on it monthly bills are estimated (considering differences between summer and winter time). It concerns electricity, gas as well as heat supply. Heat supply concerns in about 80% multifamily buildings and additionally is supervised by buildings administrations. Prepaid meters are not used in Poland.

In the context of energy market liberalisation since July 2007, the energy use on the hourly basis is going to be substituted by the energy consumption profiles. However, in the whole country scale, only few households are using this option at the moment and there is no pressure for AMR implementation.

There are no legislative/regulatory initiatives foreseen by the administration. Some DSOs in cooperation with meter manufacturers do some research and development projects.

Status for smart meters	Little interest in housing sector. Common and spread in industry and commercial sectors. 2-3 pilot projects developed by DSO and manufacturers.
Main driver for smart meters	Improvement of DSO's efficiency and customer service.
Current meter practise	Hourly readings for large industrial and commercial customers. Two-three readings a year in households.
Governments position	Not active.
Regulator position	No initiatives. Promotional
Electricity sector position	Convincing large energy consumers.
Other energy sector position	Passive. Few pilot projects and limited development activities.
Existence of energy poverty and/or pre paid meters	Energy poverty expected and prophesied by experts. No pre paid meters.
Other policy of relevance for smart meters	-

4. Summary

The status of smart meters is very different in the surveyed countries. In some countries very little attention is given to smart meters, while others have implemented or are in the process of implementing a completely new meter infrastructure.

Investments in smart meters are considerable. Benefits include better service (avoid estimated bills, more frequent reading, monitoring of quality of supply), operational aspects, improvement of market aspects (e.g. easier change of supplier, avoid profiling or demand response), potential energy savings from better information of energy consumption to end-users and other issues. This complex picture may be part of the background for the variation in the status for smart meters. However, the countries discuss smart meters in a variety of ways.

In some countries, such as Denmark, the main focus has been on the potential for increasing demand response by supplying smart meters to households. In other countries, such as UK, the main focus is on the potential for improving energy efficiency through better feedback of meter data to end-users. In other countries, such as Sweden, the main issue seems to be a public debate about inaccurate billing.

Smart meters could probably become more widespread if the political debate as well as the regulatory studies could maintain a broad view on the cost and benefits of new meters. If some benefits are omitted, the smart meters are not likely to be supported.