Impacts Analysis on European Metering Industry Stakeholders

Project: European Smart Metering Alliance

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1. EXECUTIVE SUMMARY

Smart metering is being examined across Europe as a consequence of its promotion in the Energy End Use Efficiency and Energy Services Directive (ESD). This Directive must be implemented by European Members States by 2008 and requires utilities to provide final customers with information on their energy consumption; via their bills, web links or in-house displays. ESMA has been formed to support Article 13 of the ESD and seek to maximise the energy savings benefits of smart metering. ESMA has established a forum of involved stakeholders who can debate and guide the many issues surrounding the development of smart metering. In addition, the ESMA project team is preparing a series of reports on the environment for smart metering and will publish an Application Guide. This report is one of this series of report and sets out the impacts that smart metering might be expected to have on industry stakeholders. The purpose of the report is to identify beneficial impacts that might need encouragement and disadvantageous impacts that should be mitigated.

The key stakeholders identified are; Utilities (RESCs, DSO, Meter Operators and Asset Providers, Data Collectors and Processors), Final Customers and Consumer Bodies, Vendors (of smart meter related meters, displays, communications components, services and software), Regulators, Governments and the European Commission and Energy Agencies.

In summary, the major impacts identified are:

- Improved integration of embedded generation and renewable generation capacity into the electricity network.

- Enhanced capability to implement demand response measures and manage power demands.

- Improved operation of the retail energy markets and support the liberalisation of energy markets.

- Requirement for major investments in new metering systems and supporting IT systems. This will be countered by cost savings. The relative proportions will need to be examined for each implementation. This investment will create major export opportunities for the European meter industry.

- Smart metering will provide final customers with more and better information on their energy usage. On the basis of previous pilot studies, this might be expected to lower consumption by between 15% – 5% for direct feedback and between 5% - 0% for indirect feedback. It must be stated that there is no common agreement on where savings will end once the technology and market is mature.

- The provision of real time data within the home will create new markets for energy monitoring equipment and systems. It will also enable new opportunities for energy savings measures that will depend on the real time feedback of consumption data.

- Smart meters will increase residential power demand by around 0.8%. Energy savings must achieve this saving before they are even carbon neutral.

- The requirement for people to manually read meters will diminish greatly. This

will reduce employment levels but there is an opportunity to re-train meter readers to carry out support work on the new systems.

Arising from this study it is recommended that the metering industry:

- agrees an energy usage budget for smart metering systems that is consistent with the likely energy savings.

- agrees with consumer bodies how the increased availability of customer usage data can be used by RESCs.

- raises and investigates the possibility of new energy savings opportunities arising from smart meters with energy agencies.

2. INTRODUCTION

This report, Deliverable 2, has been prepared as part of Work Package 2 of the European Smart Metering Alliance (ESMA) project (http://www.esma-home.eu). The report explores the impacts that could arise from the introduction of smart metering into the European Union. For this report the definition of smart metering is taken to be that given in Deliverable 3 "Definition of Smart Metering and Applications and Identification of Benefits[i]. This definition is set out in full in Appendix A. The key point of the definition is that it assumes that smart metering will include customer feedback as well as the remote meter reading and management features of smart metering. This will be in line with the requirements of Article 13 of the Energy End Use Efficiency and Energy Services Directive[ii] (ESD). Consumption feedback is assumed to reduce the energy usage of final customers. The evidence for this assumption is being collected in Deliverable 6 "Report on Effective Customer Feedback Mechanisms"[iii] and is not expanded on here. A number of the other impacts are also being reported in greater detail in other Deliverables and, where this is the case, it has been made clear. Also, Work Package 3 will produce Deliverable 11[iv], a Financial Toolkit for assessing smart metering schemes. This Toolkit will enable financial analyses to be carried out into the impacts so, as this work has not been carried out when this report was written, the financial impacts in this report have not been fully analysed.

3. SCOPE OF REPORT

3.1. Energy Supplies Considered

This report considers the impacts arising from the implementation of smart metering for electric, gas, heat and cooling energy supplies, as envisaged by the ES Directive. At present, electricity is in the forefront of smart metering. This is principally as a consequence of the ready availability of an electric power supply in electricity meters. However, smart metering can be implemented for all energy supplies. In the impacts below, statements apply to all types of energy supply unless otherwise stated.

3.2. Market Sectors Considered

The report mirrors the scope of Article 13 of the ESD; primarily residential and small commercial final customers. Smart metering is equally applicable to use for larger customers and this is increasingly becoming common practice but is outside the scope of this report.

3.3. Countries Included

The report covers all European Member States plus Norway.

4. STRUCTURE OF THE REPORT

Impacts have been considered arising from the introduction of smart metering into European Union member states. To produce this document the author generated a list of impacts. This was reviewed by the ESMA project team, and finally, reviewed by members of ESMA.

The impacts have been split between a number of different headings covering the main impact areas. For each Sector, a series of impacts have been listed and for each of these impacts a consequence has been described that is what might be expected to follow from the impact. There is also a statement of which actors will be affected by the consequence

and an assessment of its level of impact (low, medium and high).

For a number of the impacts there is more than one consequence and, where this is the case, these have been treated in turn as Consequence 1, 2 and so on.

5. WHO ARE THE STAKEHOLDERS?

The stakeholders who will be affected by the introduction of smart metering depend on how the market has been structured in each European Member State. However, whatever the local arrangements, the stakeholders must include a number of functional entities and these definitions have been used in this document. It is necessary to interpret the actual stakeholders in each member state according to the local arrangements. The parties are:

Retail Energy Supply Company (RESC), the company that contracts with the final customer to provide energy, either existing companies or new entrants.

Distribution System Operator (DSO) the organisation responsible for the low voltage electricity, low pressure gas or hot water distribution system that directly connects with the final customers premises. The DSO's network interfaces with the meter.

Meter asset provider (MAP); the organisation that owns the meter and is responsible for their purchase, maintenance and replacement.

Meter Operator (MOP): the organisation responsible for the installation, maintenance and replacement of meters.

Data Collector (DO): the organisation that retrieves data from the meter and passes it into the billing process.

Data Processor (DP): the organisation that receives meter reads from the DC and processes them to arrive at charges for the final customer and, possibly, payments between the RESC and their wholesale energy suppliers.

Final Customer: the residential or small commercial customer that purchase energy from the RESC and depends on the meter to measure t heir consumption.

Vendors: a range of companies including the manufacturers of meters, customer displays, communications infrastructure (such as communications concentrators) as well as those that write the major programmes needed to operate a smart metering scheme.

Regulators: In all Member States there are regulators that are responsible for the energy supply companies; electric, gas and heat. Often the Regulators are responsible for supporting governments in interpreting the implementation of Article 13 of the ESD.

Energy Agencies: national and local bodies that have a remit to reduce energy consumption.

Consumer Bodies: national and local bodies that represent final customers and defend their interests.

Other Stakeholders: Other stakeholders include national governments and the European Commission. The Transmission System Operator (TSO) can also be affected where there are major common effects with regard to final customers, such as demand response.

6. SUPPLY AND DEMAND IN EUROPE'S ELECTRICITY MARKETS

To set a background for this report a simple analysis of the energy consumption of the household and small commercial sectors is included.

"There are in total 240 million electricity customers in Europe, of which almost 20 per cent in Germany and about 12–13 per cent in the UK, France and Italy respectively. The total electricity consumption in Europe (EU 25 plus Norway and Switzerland) amounted to 3,150 TWh in 2004. Annual consumption is expected to increase by an average of 1.7 per cent until 2010, primarily in Southern Europe and Central Eastern Europe"[v].

"In the year 2002, gas flowed through more than 83 million meters, meeting the energy needs of more than 210 million individual customers.[vi]"

In 2005, according to Eurostat data, the overall energy consumption of households, services and trades was 480 million toe for the EU27 countries and 62.5 million toe for electricity alone.

The ESD places an obligation on the governments of Member States to reduce their energy consumption by 9% over the 9 years from 2008. It is generally accepted that one of the most difficult sectors to achieve savings is the residential market. Thus this report is written against a background of governments that are required to implement the ESD and that are under pressure to achieve major energy savings across all market sectors.

7. ANALYSIS OF IMPACTS

7.1. Distribution System Operation

7.1.1. **Impact:** ***Smart meters can be equipped to measure power quality and this information can be collected to provide greatly increased levels of monitoring of the distribution system***

Consequence: *DSO's will be able to manage their networks better., improve reliability, reduce operating costs and make better investment decisions through a better understanding of their operations. This can also lead to lower numbers of calls to customer call centres and improved accuracy in answering them. Traditionally, DSO'S have not monitored the LV or low pressure gas networks as this was seen as unnecessary. The benefits above are positive outcomes from installing smart metering into a conventional LV network. For electricity networks, there will be even greater benefits where there are high levels of distributed generation connected to the low voltage network.*

DSO's will have the option of installing a full SCADA system to duplicate this functionality but using smart meters will reduce the costs of this extra functionality. Where the market has been unbundled and the meters do not fall within the control of the DSO, there will be issues about how the DSO gains access to the meter data and how they pay for it.

Those affected: *DSO*

Impact level: *Medium – for conventional networks*

High – where there are high levels of embedded generation

7.1.2. **Impact:** ***Smart meter systems can be fitted that can be used to disable or reduce the customer consumption when the Network cannot meet a peak demand.***

Consequence: *RESCs will be able to use the meters to operate demand response schemes that protect the stability of the LV system. It can be assumed that the customers would enter into contracts with the DSO to be rewarded for agreeing to this arrangement. By having control of the maximum load on the system, it would be possible to avoid or delay reinforcement of the LV, MV Distribution networks, Transmission System and to avoid increases in generation capacity. The topic of Demand Response is dealt with fully at the following web site www.demandresponseresources.com .*

This consequence links to 7.5.4.

Those affected: *DSO,TSO, RESC, Final customers*

Impact level: *High*

7.2. Retail Operations

7.2.1. **Impact:** ***Smart meters will permit the direct downloading of meter data. This can be performed at pre-programmed times or on-demand.***

Consequence 1 *Accurate, frequent billing will reduce customer complaints and call centre work load giving rise to fewer dissatisfied customers and lower customer churn, where markets are open. The ability to make an on-demand call to a meter during a call to a final customer will also facilitate the operations of the call centre. The response time of the meter system will be important in determining the usefulness of this feature; final customers will not willingly wait for long during a call for the data from the meter.*

Those affected: *RESC, Final Customers, Governments (by virtue of increased market competition)*

Impact level: *High*

Consequence 2 *RESCs will need to make significant changes to their billing software and presentation of bills. This will require funding and can create short term problems as the new software is introduced.*

Those affected: *RESC, Regulator, Final customer, Vendors*

Impact level: *High*

Consequence 3 *The attitude of RESCs to metering assets will change from a simple device required for billing purposes to a key link to the final customer and the basis of a more complex commercial relationship. Governments and the European Commission (expressed via the ESD) have an expectation that RESCS will develop their relationship away from a simple supplier of kWh's to a provider of energy services. This is expected to allow RESCS to develop their business whilst at the same time reducing the kWh's sold. Smart metering, due to the greater functionality of the meter and the introduction of 2-way communications and a customer display can be expected to support this move to energy services. There is also the possibility that, where the metering market has been unbundled, the party responsible for providing the meter may see a way of increasing its revenues by offering greater levels of functionality, rather than by reducing the costs of metering.*

Those affected: *RESC, Meter asset owner, Final customer*

Impact level: *High*

Consequence 4 *Suppliers may receive far higher levels of information on their customers' energy usage. This may be used to tailor supply contract offerings and allow RESCs to offer better tailored contracts to customers. This consequence will only fully arise where interval metering is implemented and the final customer's energy usage is obtained by the RESC at a resolution of 10 – 60 minutes. Where the meter is only read more frequently, such as monthly, the RESC will not gain much greater insight into the final customer's behaviour. It may be possible that the final customer will volunteer data about their usage, such as on the RESC web site and will provide similar levels of information.*

This consequence is linked to Consequence 7.7.2

Those affected: *RESC, Final customer,*

Impact level: *Medium*

Consequence 5 *In some markets, where final customers are free to switch between RESCs, it is claimed by some that the a lack of accurate consumption data for the final customers makes it difficult for a new RESC to properly assess the final customer. Where this is the case the increased availability of customer data may facilitate the customer transfer process. This would depend on the data being made available to the new RESC or the Final customer, which may require Regulatory intervention.*

Those affected: *RESC, Final customer, Regulator*

Impact level: *Medium*

Consequence 6 *The introduction of smart metering will result in changes in the cost of metering. These costs will:*

Increase due to: higher cost meters, higher communication costs, higher maintenance costs.

Decrease due to: lower data collection costs, lower costs for disputes

The correct attribution of these costs to the appropriate beneficiary is a key issue for the implementation of smart metering, especially in markets that have been unbundled.

The relative importance of these cost changes will be dealt with quantitatively in Work Package 3, Deliverable 11 – Financial Toolkit.

Those affected: *RESC, DSO, Final customer*

Impact level: *High*

7.2.2. **Impact:** ***Smart meter data can be used to pinpoint locations where fraud levels are high***

Consequence: *Meter fraud will be easier to detect using smart meters. This will result in higher recovery of revenues and less money spent on fraud detection, Where AMM is implemented, the supply to problem sites can be disabled, even when access cannot be gained to the property to disconnect it. It should also be noted that smart metering, by virtue of the implementation of 2-way communications, will expose the metering system to new avenues for fraud. These will have to be carefully studied and appropriate security measures introduced to ensure the system is resilient.*

Those affected: *RESC, Final customer, Regulator*

Impact level: *High (where fraud is a significant issue)*

7.2.3. **Impact:** ***Smart meters can be fitted with a switch or valve to disable the supply to the property***

Consequence 1 *Through the combination of a smart meter, 2-way communications and a switch/valve, it should be possible for smart meters to make it possible to remotely change a meter from credit to pre-payment mode. Energy costs for pre-payment final customers will be reduced and brought more into line with credit customers. As pre-payment final customers normally have lower incomes than credit customers, it is unfortunate that they face higher costs for their metering. Delivery of this consequence will depend on the switch/valve being fitted as standard to all meters. There are a number of other benefits for the RESC and DSO to be gained from the meter containing a switch/valve (7.1.2, 7.2.2, 7.2.3(2)) and these could each contribute towards the financial case for the inclusion of the switch/valve.*

Those affected: *RESC, Final customer, Regulator*

Impact level: *High*

Consequence 2 *Customers can be offered novel tariffs based on maximum demands or including the option to disconnect them. Much depends on how the switching is done. It can be by a separate switched circuit, that can safely be turned on and off remotely or as the whole house supply, in which case there will be a need to manage the use of the switch. For gas supplies it is more problematic isolating a supply and it might be preferable to use smart metering to control house appliances, for instance delaying the use of hot water heating.*

Those affected: *RESC, DSO, Final customer*

Impact level: *Impact*

7.2.4. **Impact:** ***Smart meters (assuming they are compliant with the ESMA definition) will provide more energy usage information for use within the dwelling.***

Consequence: *It would be possible to provide electronic access to the data for use by other programmes or devices. This could create a new market for energy services products. For instance, house heating appliance control systems would be able to interrogate the meter for cost or carbon data about the energy being used and optimise on this basis rather than simply aiming to minimise kWh's of energy input to the system. Also, the RESC could use house parameters, such as temperature, to support energy service products.*

Those affected: *RESC, Final customer, Market entrants, Smart homes industry*

Impact level: *High*

7.2.5. **Impact:** *Smart meters will provide consumption data for new market entrants, such as Energy Service Companies (ESCO's)*

Consequence: *Implementation of smart metering (AMR) and data collection systems can be helpful and can facilitate selection of energy efficiency improvement projects for RESCs and/or ESCO's (based on data on energy consumption – identification of potential projects, estimation of the energy efficiency potential, determination of energy consumption baselines, energy cost baselines, etc.)*

Those affected: *ESCO's, Final customer,*

Impact level: *Medium*

7.3. Energy Efficiency

7.3.1. **Impact:** ***The implementation of smart metering according to the ESMA definition will provide more energy usage information on customer bills and statements.***

Consequence 1 *There is an expectation that customers will respond to some extent to seeing consumption data on their bills; such as bar graphs showing consumption over previous billing periods. In the UK the government has made an assumption of 1% – 5%reduction in energy usage resulting from the inclusion of energy consumption data on the bill. Deliverable D6 "Report on Effective Customer Feedback Mechanisms" will collate and report on the evidence for this saving. However, for the UK a reduction in 1% in domestic energy usage would correspond to an annual saving of 0.62 million toe. If the saving where to be extended to the whole of Europe this would represent an annual saving of 4.8 million toe. A major feature of smart metering is that the principle of providing customers with more information applies equally to all energy streams (gas/electric/heat/cooling) as well as to all European Member States.*

Those affected: *RESC, Energy Agencies, Final customers, Governments, European Commission*

Impact level: *High*

Consequence 2 *By having more data on the final customers' energy consumption, the RESC's can offer better tailored energy consumption advice to final customers via their bill or other energy savings programmes. It may be possible for RESCs to work in combination with Energy Agencies to better meet each parties' needs; by providing better access to final customers for the energy agencies and by providing better energy advice for the RESC's.*

Those affected: *RESC, Final customers, Energy Agencies*

Impact level: *Medium*

Consequence 3 *RESC's can offer online information for their final customers, possibly as part of online billing via the RESC web site. This would allow final customers to combine their knowledge of their dwelling and its occupation patterns with billing data and advice from the RESC. Although not all final customers would be interested in such a service, those that were would gain access to better targeted energy reduction advice. The RESC could also offer energy saving measures on the basis of much better understanding of the need and could offer a simple cost benefit analysis. The overall consequence of this would be to develop a greater relationship between the RESC and the final customer, with corresponding opportunities to advise final customers.*

This consequence links to Consequences 7.2.1(4) and 7.7.2.

Those affected: *RESC, Final customers, Energy Agencies*

Impact level: *Medium*

Consequence 4 *AMR will create possibilities for development of the benchmarking systems aimed at the energy efficiency and energy consumption issues for particular types of end users, types of buildings, etc.*(recently benchmarking became more and more popular in EU countries and in EC especially).

Those affected: *RESC, Energy Agencies, Final customers*

Impact level: *Medium*

7.3.2. **Impact:** ***Smart metering implemented according to the ESMA definition will provide more, real time energy usage information to final customers via in-house displays.***

Consequence 1 *There is an expectation that customers will respond to a greater extent to consumption data from in-house customer displays. The extent of this saving will be reviewed as part of WP2, Deliverable 6. This is an expectation of the ESD and can form part of the Member States' 9% energy saving over 9 years required by the ESD.*

Savings between 15% – 1% have been attributed to smart metering. If this were achieved across Europe for all energy streams, then this would lead to a total annual carbon saving of 72 – 4.8 million toe.

Those affected: *RESC, Final customers, Energy Agencies, Government*

Impact level: *High*

Consequence 2 *Customer displays and the in-house infrastructure to support them could create a market for enhanced forms of information feedback yielding increased and sustained energy savings. This will offer a new route for Energy Agencies, academics and RESCs to focus their final customer centred activities. At present there is little experience of such feedback systems and here is a need, and opportunity, to develop them to achieve enhanced savings.*

Those affected: *RESC, Final customers, Energy Agencies, Market entrants*

Impact level: *High*

7.3.3. **Impact:** ***Smart meter data can be used to measure the impact of other energy savings measures***

Consequence: *By providing much higher resolution, time stamped data, it will be possible to analyse the effect of other schemes, such as fitting low energy light bulbs, where such analyses are currently not possible except via expensive monitoring projects. In many cases the overall impact of specific energy efficiency measures are unknown and have to be estimated from the measured effects on a small number of pilot schemes. Having good data on impacts will be increasingly important as governments work harder to reduce the energy consumption of the domestic and commercial sectors. This will also support the activities of Regulators if they are required to validate savings by RESCs.*

Those affected: *Energy Groups, RESC, Regulators*

Impact level: *High*

7.3.4. **Impact:** ***Smart meter components and infrastructure can be linked to other energy savings schemes.***

Consequence: *If smart metering is widely introduced it is likely that it will be used by other energy efficiency schemes to improve their operation. This may include, for example, linking the central heating controls to the smart meter so that they can share data. Also, energy savings measures such as high efficiency light fittings and focus on turning off standby loads can use smart meters to give immediate feedback on the energy savings. This can result in positive feedback and encouragement to take savings further.*

Those affected: *Energy Groups, End customers, Product developers*

Impact level: *Medium*

7.3.5. **Impact:** ***Smart metering will create an opportunity for energy efficiency agencies to devise enhanced energy savings measures based on the use of smart meters.***

Consequence: *Once smart meters are installed there will be opportunities for energy efficiency professionals to tailor energy saving measures specifically for use with in-house displays; for instance, there could be a focus on night standby loads as these are clearly shown by a smart meter display.*

Those affected: *Energy agencies, Final customers, RESC's*

Impact level: *Medium*

Impact: *Smart Metering data can be made available to authorised parties, such as Governments*

Consequence: *Smart Metering (AMR) can be a good basis for improvement and development of the national/local statistical systems and allow analysing of dynamics and trends in energy consumption in division into particular types of energy end-users, types of buildings, etc. It is important from the point of view of proper and accurate planning of new law regulations, possible supporting schemes and/or any other (necessary) interventions. Such data is currently not available.*

Development of Smart Metering would also be a good basis for the development of more comprehensive energy management schemes on local (town) and regional (district) level and significantly support local energy planning

Those affected: *Governmental/local authorities*

Impact level: *High*

7.3.6. **Impact:** ***Smart metering data can be provided to operatives or software systems monitoring heating/cooling systems.***

Consequence: *Smart metering consumption data will allow the monitoring the correctness and fitting of control systems operation in heating/cooling installations and enable the immediate identification and reacting to the failures and irregularities in heating/cooling systems operation*

Those affected: *Final customers, heating/cooling system maintainers.*

Impact level: *Medium*

7.3.7. **Impact:** *Smart metering data can be provided to support the Energy Performance of Buildings Directive (EPBD)*[vii]

Consequence: *Smart metering can significantly contribute to increase of the quality of building certificates and allow easier checking of the quality of building certificates (with some additional data).*

Implementation of the Total Quality Control (TQC) systems for building is planned in the nearer or further future and the implementation of energy certification and energy management (also based on the Smart Metering) will be good basis and starting point for implementation of TQC.

Those affected: *Final customers, Building managers*

Impact level: *Medium*

7.3.8. **Impact:** ***Smart meters will consume more energy than traditional meters.***

Consequence: *Increased power consumption for metering and, depending on where the power is taken, higher bills for final customers. There is an allowance under Clause 7.3.1 of BS EN 62055-31*[viii] *that meters should consume no more than 3W per meter. It is not easy to get figures for how many meters there are in the European Member States. However, from the Vattenfall and Eurogas Web Sites it is stated that there are 240 million electricity customers and 210 million gas customers in Europe. If it is assumed that each electricity customer has 1 meter, this would result in 240 million electricity meters. At 3W each, this equates to 6.307 TWh/y.*

Gas meters can be expected to use less energy as they will be battery powered thus having more pressing limits on their power consumption. Meter manufacturers will be under severe pressure to provide gas meters with a minimum 10 year battery life. To achieve this manufacturers will use low power designs. It is also possible that gas meters will use the electricity meter as a data concentrator, so that much of their power demand will be transferred to the electricity meter. It is understood that currently available batteries will support no more than one low power radio communication every 30 minutes, if the 10 year battery life is to be met.

Against the power demand increase can be balanced the end of the need for house visits will produce a reduction in energy consumption.

However, total energy consumption within the domestic sector in the EU27 countries is 3608 TWh/y and [illegible] TWh/y for electricity alone[ix]*. This implies that smart metering will add 0.8% to the electricity load of final customers. This sets a minimum energy saving that smart metering must achieve even to have a neutral impact. However, if the energy consumption of these final customers can be reduced by 5%, which is in line with the expectations from many sources, then the energy benefit of smart metering will be strongly positive.*

It is clear from this analysis that the energy usage of smart metering cannot be neglected as it is of the same order as the savings. This implies that consideration of energy burden of the metering must be included in the implementation of smart metering. It is also suggested that, rather than a figure of 3W, which relates to power supply capability, an annual kWh budget should be allocated that can accommodate the variable power demand that smart meters will be subject to.

Those affected: *RESC, Energy Agencies, End customers, Meter manufacturers, Standards bodies*

Impact level: *Medium*

7.4. Metering and Settlements Operations

7.4.1. **Impact:** ***Smart meters will be fitted that have remote communications connections.***

Consequence 1 *Meter operators will not need to visit meters as often as they can be re-configured remotely.*

Those affected: *Meter operator, RESC*

Impact level: *High*

Consequence *2* *Smart meters will be far more sophisticated than current meters and contain more components and this will lead to more failure modes and failures that will require more site visits. It is impossible to predict the number of visits but it can be expected that electronic meters will require more maintenance than old electro-mechanical meters. Meter asset purchasers will want a good understanding of the reliability of meters before they install them, as additional visits will compromise the cost benefit analysis for smart meters. Meter manufacturers will need to provide estimates of this.*

Those affected: *Meter operators, Meter asset providers, Meter manufacturers*

Impact level: *Medium*

Consequence 3 *The greater cost of meters and installation will make RESCs less willing to write off meters when final customers switch. This may result in a move to common specifications for meters and common functionality. At present there is little need for interoperability between meters in retail markets. The main requirement of meters is that they can be read by a visiting data collector, normally a case of making one or two registers visible, which is also a requirement of the MID . If there is a move to smart metering then there will be much more data and also interfaces with the data and meter. All of these interfaces much map correctly, and survive changes in RESC and other business processes. The need to guarantee this resilience will lead RESCs to seek common standards and operating protocols. This would have a major impact on the meter manufacturing industry, which would have less freedom than now to compete and innovate.*

Agreement on common protocols will also require major cross industry cooperation. Indeed, in fully competitive markets, the necessary cooperation may be close to or beyond the legal ability of stakeholders to work together without contravening competition law.

Where final customers choose to own their own meters this freedom may be compromised by the need of the RESCs to maintain an interoperable system

Those affected: *RESC, DSO, Regulator, Meter manufacturers, Meter operators and providers*

Impact level: *High*

Consequence *4* *Data processing and settlements software and procedures will need to be revised to accommodate smart metering data input. Where there is no change in the basis for billing, i.e. there is no change from non-interval to interval billing and no increase in the number of registers, and then there will actually be little change to the meter data. It may be retrieved more often and it may contain fewer estimates, but the data content will be the same – a simple meter advance. This will not be the case if there are significant changes in the use of variable tariffs or an increase in the number of tariffs. Also customer billing software may need to be changed if there are changes to the customer contract or new data items added to the bill. Changes to data processing and billing software are significant owing to the cost and the potential for serious negative impacts if there are errors in the software.*

Those affected: *Data processors, Market managers, RESC*

Impact level: *High*

Consequence *5* *The shift to remote meter reading will eliminate jobs for manual meter readers. We do not have any figures for employment levels across Europe but, assuming 240 million electricity and 83 million gas meters being read 4 times a year would require 1.29 billion meter reads per year. Assuming each meter reader takes 5 minutes per read and works for 8 hours per day for 200 days per year, this would require a work force of 67,000 across the EU27 member states. The displacement of this labour force will be a major component of the smart metering cost benefit. Although some meter readers will still be required to read meters that cannot be connected to the remote meter reading network or for meter read checks, there will be a significant fall in the number of meter readers.*

Those affected: *Data collectors.*

Impact level: *High*

7.4.2. **Impact:** ***Smart metering will allow different utility meters to be linked (such as electricity, gas, heat and water).***

Consequence: *By the use of the electricity meter as a hub (a component that links a local device to a remote data collector), smart metering can be cost effectively extended to other utilities. Other hubs than the electricity meter can be used but whatever is used, the use of a hub avoids the issues of battery life for long distance communications between gas, heat and water meters. This could also allow these meters to report their consumption data more frequently locally, thus making the data from them more useful to final customers.*

There are many issues that would arise if multi utility metering were to be implemented. Crucially, in many countries, it is unlikely that the RESC for gas, electricity and heat will be the same. From this it follows that there will need to be agreement between the different RESCs to share the communications networks and access to data stores. Possibly it will also be necessary to agree rents between the parties to share the costs. To complicate this there will need to be provision for partitioning the risk between parties. Once the commercial arrangements have been sorted then there will also need to be agreements to ensure that data is only received by the appropriate party. This would be especially true if the RESCs are in competition for the final customer.

Those affected: *RESC's, MAPs, MOPs, DPs*

Impact level: *High*

7.5. Distributed Generation

7.5.1. **Impact:** ***Electricity smart meters will have export as well as import registers.***

Consequence *1* *Those installing distributed generators in their properties will no longer need to have an export meter fitted. Getting an export meter fitted has proven to be difficult to achieve in some markets as well as adding cost and time to the installation process. It will be straightforward for meter manufacturers to offer an export register in addition to the other import registers. The meters recognise export already, the only requirement is to store the data in a register and calibrate the meter for exports.*

In some European markets the generator is connected directly to the low voltage network and the power does not flow through the meter. This is normal where the value of the power generated is higher than the cost of imported power. For these properties there would be no benefit.

In other member states, the reward to customers with embedded generators is split between an export and a generation measure. Where the generator is connected into the household power network, it becomes difficult to meter the generator output. With smart metering, it should be possible to use a local communications network to transfer the generation output from the generation meter to the import/export meter, from where it can transmitted to the appropriate RESC for processing.

Those affected: *End customers, DSO's*

Impact level: *Medium (Impact will depend on the number of final customers with their own generators)*

Consequence *2* *The use of meter reverse flow as a fraud detection measure will need to be moved from an automatic flag on the meter to a link between the meter export register and a central database recording those final customers who are registered for export. This links to the impact above. At present it is normal to activate a flag if the meter detects reverse flow. This is a reliable fraud detection method where final customers only import. However, if export is potentially a valid activity, then the fraud detection will have to be shifted from the meter to data verification process where it will be necessary to know if a final customer is registered for exports.*

Those affected: *End customers, RESC*

Impact Level: *Low*

7.5.2. **Impact:** ***Smart meters will allow interval data to be collected for embedded generators.***

Consequence: *If so desired in a given country, it would be possible to use interval data to assess the true worth of generation and export power, measured against wholesale markets. The move from profiling to interval metering for residential customers will involve very high data processing costs and is unlikely to be introduced until the number of distributed generators becomes significant. One option is to allow the smart meter to carry out some of the processing so that there is less data to communicate and less processing when it is received. There would be issues for this as billing systems normally require that data can be tracked back to its source for subsequent auditing. If the meter carries out processing such that the original data is lost, then this would be an objection.*

Those affected: *RESC, Data processors, Meter operator, Data collector, Distributed generator owners*

Impact Level: *Medium*

7.5.3. **Impact:** ***Smart meter infrastructure will allow generation meters to be linked to the import/export meter.***

Consequence 1 *Costs for collecting generation meter data will be reduced as it can be combined with the other meter data streams. This will also allow more complex tariffs and renewable reward schemes to be devised. Final customers are also understood to be positively influenced by being able to see the performance of their generators. This could be done readily on an in-house display.*

Those affected: *RESC, Final customers, Energy Agencies?*

Impact Level: *Medium*

Consequence 2 *Smart meter remote communications will allow fleets of distributed generators to be centrally controlled so that it will be possible to co-ordinate the operation of large numbers of small generators, treating them as a single, virtual, large generator*[x]*.*

Those affected: *Market entrants, Distributed generators*

Impact Level: *Medium*

7.5.4. **Impact:** ***Smart metering, through increased meter functionality and 2-way communications will allow dynamic tariffs.***

Consequence: *RESC's can offer final customers tariffs that encourage them to use electricity when there is surplus output from un-scheduled renewables (such as wind generator output). Alternatively, demand can be discouraged during periods of low demand. This could improve the environmental benefits of renewable generation. It is likely that the most benefit will be achieved if the final customer has a degree of automation provided to manage their load. The amount that final customers can modify their load depends on the discretionary loads hey have. These are loads that the final customer can choose to suspend such as fridges and freezers as they have a degree of thermal mass or loads, such as air conditioning, where the final customer may be willing to trade a suspension of service in return for some payment.*

This consequence links to Consequence 7.1.2

Those affected: *RESC, Renewable generators, Final customers*

Impact Level: *High to Medium (Impact is dependant on the available discretionary electric load - this may vary from country to country)*

7.6. Renewables and Sustainability

7.6.1. **Impact:** ***Smart metering can provide customers with up to date information about the carbon output related to their electricity, gas and heat consumption.***

Consequence: *Customers may be influenced by seeing changes in the carbon associated with their consumption - this could be due to switching to 'green' energy RESC's or reflecting the changing mix of generators and energy sources in use. This might create a greater market for low carbon RESCs, such as Electricity Suppliers that offer electricity sourced from renewable sources.*

Those affected: *RESC, Renewable generators and energy providers, Final customers*

Impact level: *Medium*

7.6.2. **Impact:** ***Smart metering with in-house displays will result in increased quantities of electronic equipment that will require disposal and, possibly, batteries.***

Consequence: *The in-house displays that would be used with smart meters will fall under the scope of the Waste Electrical and Electronic Equipment Directive (WEEE Directive), directive 2002/96/EC. There will be a need to recycle the displays at the end of their lives. Who will be responsible for this will depend on how they are provided. It may be preferable for the RESC to provide the display so that they have responsibility for recycling. This may be better than the final customers having individual responsibility. If smart metering were fully implemented across Europe then there would be approximately 250 million displays (assuming that the various utilities can share a single display). These would contain both electronic components and, possibly, batteries. These would, hopefully have a life matching the meter of around 10 -15 years. This would result in 25 – 16.7 million displays being recycled every year. This is a large quantity but not when compared to the total of electronic equipment being disposed of by final customers. It may, however, be preferable over time, to move the customer display away from its own display to a shared interface, such as the television or computer display.*

Those affected: *Final customers, RESCs, Meter manufacturers,*

Impact level: *Medium*

7.7. Social

7.7.1. **Impact:** ***Smart metering will remove the need for data collectors to access houses for meter reading.***

Consequence: *Criminals currently pretend to be meter readers in order to gain access to properties to commit crimes. Remote meter reading will reduce opportunities for criminals to access house under the pretence of reading the meter. Sadly, it is likely that criminals will find other pretences to gain entry to houses so that there will be little long term impact.*

Those affected: *Final customers, Police*

Impact level: *Low*

7.7.2. **Impact:** ***Smart metering will make available much more information on customer behaviour.***

Consequence: *There may be concerns that smart meters represent a 'spy in the home'. In actual fact, most proposed AMR schemes do not give RESC's much more information than they currently receive. In some countries, such as the UK, there is no proposal for the introduction of interval metering. In this case the RESC's will only receive periodic meter data (one reading per month perhaps). This will not tell the RESC much more than they know now. The new flow of detailed consumption data will go into the home for the householder's own use and will not be seen by the RESC.*

If billing is moved to an interval basis, as is currently proposed in France, then there will be the prospect of RESCs and other parties having access to this extra consumption information. In this case, it may be appropriate to agree with consumer bodies how any extra data is dealt with and limits placed on its use.

This consequence links to Consequence 7.2.1(4).

Those affected: *Final customers, RESC, Consumer bodies*

Impact level: *Low to medium, depending on the availability of additional data to the RESC*

7.8. Manufacturing

7.8.1. **Impact:** ***Smart metering will require the manufacturing of higher value meters.***

Consequence: *Most meters are developed in Europe and much manufacturing is carried out in Europe, although some is carried out in China. China is increasingly entering the market for low value meters and has a presence in other market sectors.*

The impact on the manufacturers will depend on how smart metering is implemented. The meters will be more sophisticated and have a higher value. Various figures have been suggested but it might be expected that a fully featured smart meter with full external and local communications capabilities plus an in-house display, would have a cost of €75 - €100 per meter. This compares to a current cost of around €10 for a simple single phase, whole current single rate electronic meter.

Those affected: *Manufacturers*

Impact level: *High*

7.8.2 **Impact:** ***The provision of in-house displays will create a new market for displays and feed back methods.***

Consequence: *Europe is well placed to become a world leader in the provision of feed back devices and the understanding of how to maximise energy savings impact on final customers. Other countries (US, Australia, Canada) are developing this market and could export it to Europe if it is not developed locally.*

Those affected: *Developers RESC*

Impact level: *High*

8. OVERVIEW – HOW WILL THE ENERGY WORLD BE AFTER SMART METERS

This report seeks to asses the impacts that would arise if smart metering were introduced into the EU27 member states as described in the ESMA definition (see Appendix A). A large number of different impacts have been described but this section seeks to portray a short picture of how the world of metering would appear after smart metering was introduced.

Major changes would be seen in the meters, which would have a much higher level of functionality plus communications links, both outside the household and within it. There would be a customer display providing final customers with rapid feedback on their consumption, allowing them to take action to reduce consumption or else linked to automated systems minimising energy use.

The relationship between the final customer and the RESC would be radically changed and there would be much a wider range of product offerings available from the RESC to the final customer. These could include energy services products. RESCs may also be expected to have a greater involvement in their customers' energy usage, driven by the requirements of the ESD.

Smart metering would have a major, and beneficial, effect on the billing process and should reduce complaints by final customers. However, this will require funding. Ideally, the investment will be balanced by reduced costs for the RESC and other parties. However, it may require regulatory or commercial pressures to ensure this balance.

Finally, the data from the meters and links to the display will be used by other bodies to support an increasing number of energy savings measures. This will be important to ensure that the energy savings benefits of smart meters are not a 'one off' gain but part of a developing change to an energy efficient lifestyle.

9. CONCLUSIONS

The introduction of smart metering across Europe will have a profound impact on the energy industry. The major impacts will be:

- Improved integration of embedded generation and renewable generation capacity into the electricity network.

- Enhance capability to implement demand response measures and manage power demands.

- Improve the operation of the retail energy markets and support the liberalisation of energy markets.

- Require major investments in new metering systems and supporting IT systems. This will be countered by cost savings. The relative proportions will need to be examined for each implementation. This investment will create major export opportunities for the European meter industry.

- Smart metering will provide final customers with more and better information on there energy usage. This should lower consumption expected to be between 10% – 1%, there is no common agreement on where this level will settle.

- The provision of real time data within the home will create new markets for energy monitoring equipment and systems. It will also enable new opportunities for energy savings measures that will depend on the real time feedback of consumption data.

- Smart meters will increase residential power demand by around 0.8%. Energy savings must achieve this saving before they are even carbon neutral.

- The requirement for people to manually read meters will diminish greatly. This will reduce employment levels but there is an opportunity to re-train meter readers to carry out support work on the new systems.

APPENDIX A

In ESMA the definition for smart metering is set as follows[i]:

Smart metering has the following features:

- Automatic processing, transfer, management and utilisation of metering data
- Automatic management of meters
- 2way 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)

REFERENCES

[i] Definition of Smart Metering and Applications and Identification of Benefits, D3 of the European Smart Metering Alliance ESMA, Editor Pekka Koponen, VTT, 3 January 2008, Authors: Pekka Koponen (ed.), Luis Diaz Saco, Nigel Orchard, Tomas Vorisek, John Parsons, Claudio Rochas, Adrei Z. Morch, Vitor Lopes, Mikael Togeby.

[ii] DIRECTIVE 2006/32/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL, of 5 April 2006, on energy end-use efficiency and energy services

[iii] Report on Effective Customer Feedback Mechanisms, D6 of the European Smart Metering Alliance ESMA, Author, Henk van Elburg, SenterNovem, October 2006.

[iv] Financial Toolkit – in preparation.

[v] Vattenfall Annual Report 2005

[vi] Eurogas web site http://www.eurogas.org/naturalGas_network.aspx

[vii] EPBD….

[viii] BSI EN 62055-31…..

[ix] Eurostat 2005

[x] European Technology Platform, SmartGrids, EUR 22040, Vision and Strategy for Europe's Electricity Networks of the Future, ISBN 92-79-01414-5, European Communities, 2006.