CONCERTED ACTION
ENERGY EFFICIENCY
DIRECTIVE

Core Theme Series Report:
Concerted Action Energy
Efficiency Directive

3

Metering and billing, demand response and grid issues

Fernando Martins, ISR – University of Coimbra, Portugal

May 2014

Content

1 Introduction and context

The Concerted Action for the Energy Efficiency Directive (CA EED) supports implementation of the Directive 2012/27/EU (EED) by fostering the exchange of information and experiences among Member States with regards of the implementation of the Directive.

This report summarises work carried out by the Concerted Action for the Energy Efficiency Directive (CA EED) Core Theme 2 between January 2013 and March 2014. Core Theme 3 looks at metering and billing, demand response and grid issues.

By providing a trusted forum for exchange of experiences and for collaboration, the CA EED helps countries learn from each other, avoid pitfalls and build on successful approaches when implementing the Directive.

The energy market is changing. Recently, many modifications have been made to European Union legislation, mainly to define rules and measures to ensure competition and proper consumer protection in the energy market.

In this context, the EED includes three Articles referring to billing and metering. Article 9 is directly related to the metering of energy consumption and Articles 10 and 11 require MS to create rules for billing information and the costs of billing homogenisation.

Article 15 of the EED is entitled 'Energy Transformation, Transmission and Distribution' and it is interrelated to Annex XI and Annex XII. The main objectives of the Article and Annexes are to maximise grid and infrastructure efficiency and to promote Demand Response.

CA EED participants from all MS provided inputs which have resulted in a comprehensive view of the challenges associated with billing, metering, smart metering options and Demand Response.

2 Current status and issues of metering and billing

The purpose of the work carried out under this topic was to share experiences and to learn about some good examples of metering and billing. Other important documents related to EED implementation that must be taken into account are the Directives 2009/72/EC and 2009/73/EC. Due to failures of the internal market in electricity and gas, the European Commission considered that is necessary to redefine the rules and measures applying to the market to ensure fair competition and appropriate consumer protection. In these two directives, the European Union goal is to have a smart meter roll-out plan for 80% of all 500 million European Union citizens by 2020.

Metering and billing

There are many different metering and billing situations in the EU for the five different energy products (Electricity, Natural Gas, District Heating & Cooling, and Domestic Hot Water). Many existing meters in the EU already reflect actual total energy consumption, but this is not the case for information on actual time of use. MS are divided about the statement that existing meters are already competitively priced. The implementation of the EED for electricity can be achieved in the short-term by almost all Member States. In some MS, the costs and technical difficulties regarding natural gas are more evident and will bring unexpected additional challenges. The implementation of EED for district heating, cooling and hot water seems to present a high degree of difficulty due to the technical and physical necessity in many situations of installing individual meters or heat cost allocators to obtain the consumption of a single end-user.

The general opinion of the CA participants was that current feedback for final customers and the definition of 'technically possible, financially reasonable and proportionate' are not yet satisfactory. There is a need for further sharing of experience and expertise to understand what type of billing information is most effective to trigger energy savings and sharing of criteria to establish what is 'technically possible, financially reasonable and proportionate'.

Regarding district heating, cooling and domestic hot water, the local situations and views on implementing the metering and billing requirements are not yet fully clear and seem to vary significantly between MS. Therefore, more effort to retrieve information from MS to construct a 'blue print' of district heating, cooling and hot water situations of the EU-27 is recommended. An important result of the work carried out under this topic is the recommendation that for heating, cooling and hot water, the individual meters should take into account both volume and temperature.

Regarding the cost of access to metering and billing information, Article 11 of the EED stipulates that MS shall ensure that final customers receive this information free of charge but most CA participants expect that energy companies will not act accordingly. Therefore, it is relevant to discuss if extra or other regulation is necessary to prevent suppliers charging customers via other tariffs.

Smart meter roll out

CA participants show a broadly similar interpretation of the relationship between the EED and smart metering: there is a clear link between the roll out of smart meters and the relevant metering and billing stipulations in the EED. The roll out of smart meters has a direct impact on costs and benefits and on technical aspects of the various stipulations in Articles 9, 10 and 11. As the roll out of smart meters is rapidly developing in many MS, it is a challenge to define the exact impact of EED on the smart meter roll outs. However, it is clear that EED does not require any type of smart meter roll out.

Regarding information supplied to end users about the potential advantages of smart meters, MS have different market models resulting in different tasks for different parties. Therefore it is relevant to explore if there will be complications if the party that should provide information is not the same party that installs the meter.

Table 1: Summary of MS experiences on CBA (Cost Benefit Analysis) on smart meters for electricity and gas (24 responses received until 1 January of 2011), source: ERGEG (Ref. document: C11RMC-44-03)

Status of CBA in CEER countries	Electricity	Gas
Countries have conducted a CBA	11	6
Positive result of CBA	7	5
Countries plan (or ongoing) to conduct a CBA (in some cases for the 2nd time)	12	14
Countries do not plan CBA	2	5
Countries with no CBA, but no longer relevant (yes/no of roll-out already decided)	3	0

Minimum information contained in the bill

Independently of whether smart meters have been installed or not, MS must ensure that the bill is presented in clear and understandable terms to final energy users (article 10, EED).

According to EED Annex VII, MS shall ensure that, where appropriate, the following minimum information is made available to final customers in clear and understandable terms in their bills:

- **a** Actual current energy prices
- **b** Actual energy consumption
- **c** Comparisons of the final customer's current energy consumption with consumption for the same period in the previous year, preferably in graphic form
- **d** Contact information from credible organisations that can help end users reduce their energy consumption.

Billing is often the starting point for a dialogue between the energy supplier and the customer. The dialogue is important and must be treated with respect. A structured system for the dialogue is a clear advantage.

Cost effectiveness assessment

In all MS, while developing a global metering and sub-metering plan, the cost effectiveness of individual metering (e.g. metering per apartment or unit) should be addressed as required by Article 9. In that sense, it is crucial to assess the actual cost effectiveness of metering, which can be determined by comparing the cost of metering plus associated added-value engineering services and measures to the value of the possible energy savings. According to the information exchanged during the CA, this assessment is generally done over a period of 5 to 6 years and is properly discounted. Of course, this is not the only possible approach (for instance, simple payback analysis can also determine the cost effectiveness of the metering system), but it is the most common approach when it comes to energy efficiency measures.

Most CA participants agree on the criteria that should be used in the cost effectiveness assessment of individual metering for heating, cooling and hot water (please see Table 2). They for instance believe that on the costs side, the costs for educating end-users to use the meter data to save energy should be taken into account. On the benefits side, the energy savings should be considered; however, the consumption reductions depend on the energy quality level of the building (case studies and pilot projects about individual metering for heating, cooling and hot water indicate an average consumption reduction of 20%).

Another important point to be considered is the difference in metering and sub-metering cost effectiveness between the public and private sector. The effective tax rate is the main reason for the difference in metering cost effectiveness between the public and private sectors. Due to the effect of taxes, public sector projects present a shorter payback than private sector projects. Typically, the public sector is also often more patient in accepting longer paybacks than in the private sector. In the public sector, payback periods of five years or less often seem to be acceptable. However, payback periods longer than two years are often not accepted in industry.

Table 2: Cost effectiveness criteria

General	Specific	
	Costs	Savings
1. Cost Elements of Economic Assessment	**I Type of costs:** a. Installation costs, including costs for metering and billing b. Operational costs, e.g. - maintenance costs - reading and processing costs - billing costs c. Costs for measures, i.e. costs other than operational costs for activities towards consumers to use the meter data to save energy. d. Calibrations costs **II Cost allocation methods** a. Cost allocation common units b. Need for compensation of inefficient individual units **III Defining other relevant cost factors** a. Subsidy opportunities b. Tax regime c. Depreciation rules	**I Type of Savings:** a. Savings on building level b. Saving in common units c. Savings on individual unit level
2. Stakeholder Analyses	**IV Relevant issues for** a. Building Owner b. Operator or supplier c. End User	
3. Specific Characteristics	**V Relevant cost issues for** a. Heating b. Cooling c. Hot Water	
4. Situations	**VI Relevant cost issues for** a. Building with central district heating b. Multi-apartment or multi-purpose building with individual units	

3 Measures undertaken and planned to enable and promote Demand Response

Demand Response is an important instrument to motivate final consumers to shift or reduce their energy consumption in response to changes in the price of energy over time, or incentive payments designed to induce lower energy use at times of high market prices, high renewable availability or when the grid security and/or reliability is compromised. **As such, Demand Response brings savings both to the consumers and utilities and more efficiency to the energy system.**

Demand Response participation involves active and engaged customers, and where appropriate, Demand-Side Management (DSM) measures by utilities to ensure an even supply of electricity by smoothing out peaks. Together, these components will bring benefits for customers, suppliers and distributors.

The Council of European Energy Regulators (CEER) described four leading principles that must be in place before the implementation of frameworks for Demand Response. These four principles are described by CEER from a customer perspective.

Reliability – in the physical supply of energy and in commercial systems and processes that provide continuous access and affect customer service levels, such as billing. It also means reliability in the processes that allow problems and disputes to be resolved transparently, fairly and quickly.

Affordability – such that charges are clear and kept to fair and reasonable levels for all customers, reflecting value for money at a level consistent with funding necessary investments to develop energy networks and to achieve energy policy targets (for example, renewable energy), taking into account the real needs of customers. This can be secured through network regulation and other appropriate measures, if and when necessary, and by providing customers with effective choice over truly competing offers and new, innovative services. Energy sector specific measures as well as wider social policies also have an important role to play, especially for the poorest and more vulnerable.

Simplicity – in how information is provided to customers, and especially residential consumers, such that it is easy for them to understand their bill and better manage their energy consumption, making the choices that are right for them. It also means simplicity and transparency in how key processes that affect customers operate. Many customers, and especially many residential consumers, want to be able to take quick and simple decisions in energy markets.

Protection & Empowerment – to ensure access to energy supplies, and to guard against unfair commercial practices and unsatisfactory outcomes, recognising the diverse needs of customers, in particular the most vulnerable in society. For customers to be engaged, to take choices and to exercise their rights as energy customers, based on trust in, and knowledge of, how the energy sector operates. As responsibilities shift and consumers are increasingly expected to become more active in energy markets (through developments such as Demand Response, smart metering, micro-generation or energy efficiency measures), it is important that their right to choose by whom and how their energy is to be provided and charged is recognised. Although this freedom could be framed by regulation, offering meaningful choice for customers (including residential consumers) is a key way to ensure their full protection.

Demand Response benefits

The most important benefit of Demand Response is improved resource-efficiency of electricity production or gas use due to closer alignment between customers' electricity and gas prices and the real value.

Increasing participation of customers (bill savings)

Demand Response implies that the customer becomes active in managing his/her consumption, in order to achieve efficiency gains and by this means monetary/economic benefits.

This means that customers, either directly or through aggregation, are expected to communicate and interact more intensely with energy companies. This is likely to create more dynamics. After liberalisation, it appeared that customers, especially vulnerable customers, were fragile for abuse. Therefore, Demand Response will require a well-balanced framework of stimulation and communication by energy companies to customers and protection mechanisms by regulation to customers.

The meaning of "participation of customers" is that, with Demand Response, the customer is no longer an end user who consumes energy and pays the bill, but has become an active market player who communicates with energy suppliers (or other market players, such as aggregators) and as a result of this communication the consumer is active in changing energy usage.

Reducing and/or shifting consumption (realising energy savings)

The European Commission estimates that the average yearly bill for the consumer can be reduced 2% to 4% if Demand Response mechanisms are implemented. It is estimated that 10% of household consumption and 20% of industrial consumption can be shifted towards cheaper periods.

Incentive payments for end users are expected to lower electricity use at times of high wholesale market prices or when system reliability is jeopardised. Demand Response aims to reduce electricity consumption in times of high energy cost or network constraints by allowing customers to respond to price or quantity signals.

More optimal use of network and generation assets

In the long term, this operational value of Demand Response can lead to reduced or postponed investments in network reinforcement and flexible thermal generation, and to less investment to meet decarbonisation targets as the electricity system is used more efficiently.

Improving system balance between generation and demand

In the short term, Demand Response can make balancing easier by shifting demand to times when there is more renewable power available and it can help manage congestion by peak-shaving; thus helping the integration of renewable energy sources in the electricity system and reducing the high operation costs of flexible generation units.

Demand Response challenges

In contrast to the wide consensus on the value and necessity of Demand Response in smart grids, there is little consensus on how to engage consumers or align industry incentives. There are several challenges for Demand Response if it is to play its expected role of flexibility provider.

Discussion on role of different actors

There is lively debate on the role of different actors, incumbent (Transmission System Operator, Distribution System Operator, Suppliers, etc.) or emergent (aggregators, manufacturers of appliances and devices, retailers in other sectors than electricity, ICT companies), in the organisation of smart grids and Demand Response.

The split incentives of intermediaries and the distribution of value of Demand Response along the value chain explain the difficulty of reaching consensus on the appropriate business model for Demand Response.

Indeed, if the whole value were to be passed on to the responding consumers, industry would not be engaged, and if industry did not pass sufficient value to the consumers, the latter would not participate in Demand Response.

Dependency on smart meter roll-out

A second challenge exists in the roll-out of smart appliances and enabling advanced metering infrastructure (smart meters). A recent survey of pilot studies on Demand Response demonstrates that smart appliances and enabling infrastructure significantly improve the responsiveness of consumers to dynamic price signals.

Yet, there appears to be a chicken-and-egg problem: without the infrastructure, smart appliances and Demand Response cannot be used to their expected potential and without Demand Response through smart appliances, the limited benefits of the enabling infrastructure do not justify the costs of its roll-out.

Furthermore, the minimum functionalities for these smart technologies to ensure their added value for consumers are not yet firmly established, instead being part of a European Commission Recommendation. Several mandates to standardise appliances and infrastructure to ensure its interoperability are still ongoing.

Current research also focuses on how consumers can offer Demand Response with their current and future smart appliances and what the benefits could be for the electricity system.

No one-size-fits-all solution

There are several more reasons why a ´ one-size-fits-all´ approach is not advisable when aiming at energy consumption reduction or shifting.

´One-size-fits-all´ approaches usually focus on providing financial incentives, assuming that people are mainly economically motivated to participate. However, there is plenty of evidence that people are not predominantly motivated by financial gains, but can also have other motivations that relate to environmental goals, health, comfort, etc.

Research on DSM aimed at energy consumption reduction has shown that approaches that target individual behaviour only without addressing the social and physical environment in which behaviours are embedded have not been very successful in achieving lasting behavioural changes. In the case of dynamic pricing, it is relevant to take account of the characteristics of the house, the appliances, and the social processes within a household.

The risk of rebound during or after the pilot is larger if individuals are targeted with financial incentives only. No social norms are addressed; no pro-social behaviour is likely to occur (which is needed if the longer-term goal is to facilitate the transition to a more sustainable energy system).

Demand Response challenges (continued)

Studies show that often a small percentage of the participants are responsible for the response, while it remains unclear why and how they responded and why the rest did not. On average, 30% of households were responsible for 80% of the load shifting (for the total energy that was shifted or reduced by end users in the pilots and studies) (see THINK-report for more details).

Ongoing ´post liberalisation´ legacy issues, such as end price regulation

Customers cannot be expected to participate in retail markets if price signals remain blurred: wholesale and retail markets should be better synchronised to ensure that well-functioning and integrated wholesale markets promote a ´level playing field´ at the retail level.

End-user price regulation - currently present in 19 out of 27 Member States – is often specifically mentioned as a barrier to Demand Response.

The reason for this is that the idea of a maximum price for end users (defined in advance by regulators) does not fit with the principle of end users paying market prices. Demand Response may need some consumer protection, such as ensuring transparent and understandable contracts and the fact that Demand Response must always be based on the explicit permission of a customer. With regard to prices, the most important principle is that customers should react to communications that reflect market prices (high or low). Limiting this will decrease the advantages of Demand Response and might flatten the attractiveness of Demand Response for all parties involved.

External point of view

Kjartan Skaugvoll, CEO of Cuculus, a smart grid facilitating company, analysed all current costs that are related to renewable energy production and are paid by consumers. He stressed in his presentation that renewable energy sources cause extra costs for consumers via hidden volatility charges in the supply tariffs but that consumers do not have the opportunity to benefit from the advantages of low marginal costs of renewables. Therefore, he recommends Demand Response solutions to allow consumers not only to pay for the energy transition but also to benefit from it by taking advantage of low marginal costs of renewables.

Demand Response pilot cases in the Netherlands

Office for Energy Regulation (ACM), from the Netherlands, demonstrated that Demand Response will only be successful if the consumer is put at its heart. One Demand Response pilot indicated that only some 20% of consumers react to standard financial impulses only. If social and emotional impulses are added and tailored to specific customer needs and situations, the participation percentage of consumers can increase to some 80% and more.

Another pilot focusing more on challenges for different market actors showed that successful Demand Response requires new market roles, such as aggregators, and amendments in current market roles, such as introducing direct communication from grid operators and suppliers to consumers.

4 Concluding remarks

Many existing meters in the EU already reflect actual total energy consumption, but this is not the case for information on actual time of use. An important result of the various CA EED activities on metering and billing is that further discussions need to take place to exchange information and experience on what is considered 'technically possible', 'financially reasonable' and 'proportionate in relation to potential energy savings' in the different MS, by sharing information on critical assumptions, costs and expected benefits.

Concerning the cost effectiveness assessment of individual metering for heating, cooling and domestic hot water, it is difficult to characterise the current situation across the MS. It is a sensitive and complex subject, not only because of its technical difficulties but also because there are many important differences between MS. Thus, there is no single solution and each MS has to adapt it to their reality. The CA discussions showed nevertheless that there is a need to legislate and invest in the combination of control systems and individual metering for heating, cooling and hot water in order to reduce the payback period.

During the CA EED activities, we have seen different set-ups of Demand Response where different actors - such as suppliers, DSOs and of course aggregators - have different responsibilities towards consumers. This is a consequence of the different market models that exist in Europe. An important factor is the responsibility of the DSO: we see pilots where the DSO provides end customers with price signals because of the DSO's responsibility for avoiding network congestion. We also see pilots where DSOs cannot give signals to end customers, because that is a sole responsibility of the supplier (or aggregator). This means we can state that the different market models in Europe affect the different market models for Demand Response. A wide range of pilots and lack of a standard market model for Demand Response indicate that Demand Response is not a standard solution.

The CA participants from half of the MS consider that Demand Response products are absolutely necessary to achieve energy efficiency effects among end users and that it is very important to involve the customer as a part of the solution.

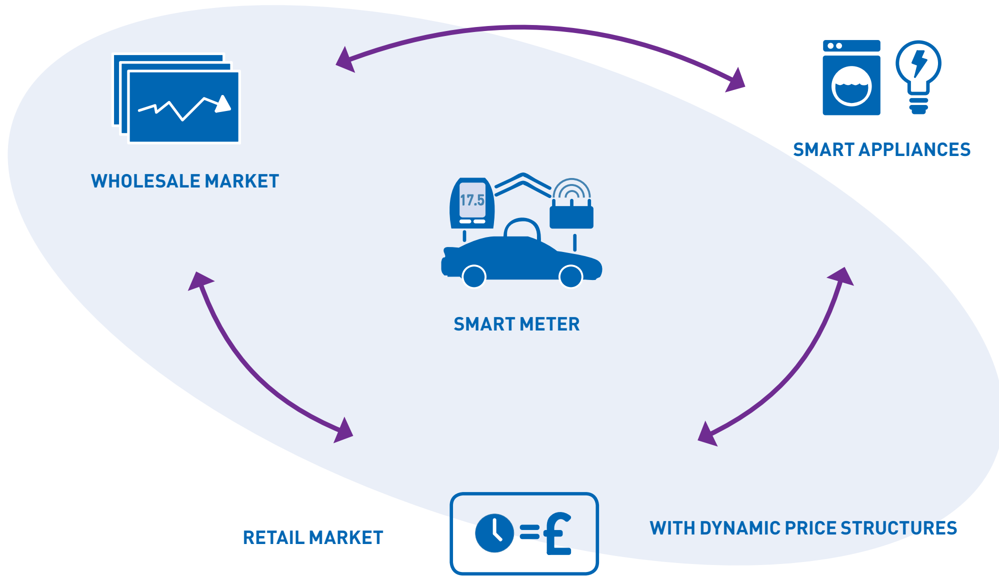
For this to happen, implementation of the EED for metering and billing is essential, and the deployment of smart meters and grid infrastructure are increasingly important (see figure 1).

Demand Response pilots show that tailor made Demand Response stimuli will result in consumers changing behaviour and contributing to energy efficiency objectives. Demand Response can only be successful if many new and existing market players are encouraged to contribute to implementing Demand Response. Demand Response solutions and dynamic pricing contracts will allow end users to pay prices that reflect market prices.

The THINK-report that was published at the start of 2013 provided a sophisticated overview of contract types and consumer preferences (risks). This overview could be used by MS to ensure that end users benefit from dynamic pricing and customer friendly Demand Response solutions that fit their needs.

Fig 1: Relationships between Demand Response and other relevant developments
(Oval shape indicates scope of EED articles 9, 10, 11 and 15)

Smart Meters and Demand Response



Notes

The Concerted Action for the Energy Efficiency Directive (CA EED) was launched by Intelligent Energy Europe (IEE) in spring 2013 to provide a structured framework for the exchange of information between the 28 Member States and Norway during their implementation of the Energy Efficiency Directive (EED).

For further information please visit **www.ca-eed.eu** or email **caeed@ca-eed.eu**

CONCERTED ACTION
ENERGY EFFICIENCY
DIRECTIVE

Core Theme Series Reports

Co-funded by the Intelligent Energy Europe Programme of the European Union