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Effect of smart metering on electricity prices






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EUROPEAN PARLIAMENT

DIRECTORATE-GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT A
ECONOMIC AND SCIENTIFIC POLICY

Economic and Monetary Affairs

Employment and Social Affairs

Environment, Public Health and Food Safety

Industry, Research and Energy

Internal Market and Consumer Protection

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BRIEFING NOTE

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Abstract

Large-scale smart meter rollout is expected to take place in most of Europe by the year 2020. Thanks to bi-directional communication between consumer and producer, this technology allows a better monitoring of energy consumption and the introduction of flexible energy tariffs, which are better suited to fluctuating renewable energy production. However, a number of issues have also been raised in relation to smart meters; particularly in relation to data privacy and the risk of an increase in electricity prices due to high investment costs passed on to the consumer. It will be fundamental for policy makers to ensure that costs and benefits related to the rollout will accrue fairly to each stakeholder, while ensuring protection of the weaker members of society.

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LIST OF ABBREVIATIONS

AMI	Advanced metering infrastructure
AMM	Advanced Meter Management
AMR	Automated Meter Reading
BEVs	Battery electric vehicles
CBAs	Cost-Benefit Analysis
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CER	Commission for Energy Regulation (IE)
CPP	Critical Peak Pricing
DECC	Department for Energy and Climate Change (UK)
DG	Distributed (Energy) Generation
EDRP	Energy Demand Response Project
EED	Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on energy efficiency and repealing Directives 2004/8/EC and 2006/32/EC
ERSE	Entidade Reguladora de Serviços Energéticos (PT)
ESCO	Energy Services Company
ESD	DIRECTIVE 2006/32/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 April 2006 on energy end-use efficiency and energy services
ETSI	European Telecommunications Standards Institute
FERC	Federal Energy Regulatory Commission
NIST	National Institute of Standards and Technology (US)
NREAP	National Renewable Energy Action Plan
OFGEM	Office of Gas & Electricity Markets
RTP	Real Time Pricing
SGIG	Smart Grid Investment Grant (US)
SGIP	Smart Grid Interoperability Panel (US)
TOU	Time of Use
WHO	World Health Organisation

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EXECUTIVE SUMMARY

Background

In 2009, the EU voted Directive 2009/72/EC, creating common rules for an internal market in electricity and laying the groundwork for an efficiently managed electricity network. The directive encourages the introduction of smart grids, distributed generation and energy efficiency. In order to optimise the use of electricity, it encourages the introduction of "innovative" pricing schemes and prescribes cost-benefit analyses (CBA) for large-scale smart meter rollout to be carried out until September 2012. Coming closer to that date, stakeholders and policymakers have voiced concerns about the risk of increasing electricity prices, increasing electricity expenditures for households and privacy infringements due to the rollout.

Aim

The objective of the present briefing paper is to analyse the effects of large-scale smart meter deployment on electricity prices and expenditures on end-users. The paper looks at price evolution based on existing flexible tariff regimes and changes in the behaviour of consumers accordingly. It also includes an assessment of the effects under different energy generation scenarios. The results are based on country trials, acknowledging that some findings may not be applicable throughout the EU. Other issues linked to smart meters, such as privacy or competition problems, are also considered. The paper concludes with recommendations for policymakers at European and national level.

Headline results

Current experiences with smart meter rollout

According to Directive 2009/72/EC (directive on the internal electricity market), Member States are required to evaluate the effect of a smart meter rollout via cost-benefit analyses (CBAs). At present, in Europe, only Sweden and Italy have implemented a full rollout, while a number of countries are currently analysing the implications by means of a CBA.

The Swedish government fostered the rollout by promulgating a law that required Distribution System Operators (DSOs) to provide monthly billing on actual consumption by the end of 2009. In Italy, ENEL (the national DSO at the time) began its large-scale smart meter deployment in 2006 via the project *Telegestore.* The main objectives were the reduction of meter reading costs as well as the avoidance of revenue losses due to electricity theft.

Looking at international experiences outside the EU, the US and the state of Victoria in Australia are analysed in more depth. The US is promoting smart meter rollout via the Smart Grid Investment Grant (SGIG), a grant system with the intention of fostering smart grid technologies across the whole country. Due to a high number of DSOs and the risk of **technology lock-ins for end-users**, the role of standardisation has gained momentum. The National Institute of Standards and Technology (NIST) was thus mandated to issue standards for communication protocols and the smart meter technology.

The example of the government of Victoria in Australia shows the need for a complete and careful CBA. Announced in 2006, the rollout was stopped due to **strong public opposition** and commercial miscalculation by the DSOs.

In terms of costs of smart meters and smart metering, from existing experiences, CBAs and studies, we can derive that three major aspects influence the price of smart meters for operators:

- The technology and amount of functionalities;
- The costs related to Information Communication Technology (ICT) infrastructure;
- Other costs, more difficult to quantify, such as installation and maintenance costs.

Main actors' roles and cost-benefit analysis

The role of the different stakeholders may vary according to the level of market liberalisation in the country considered.

In most countries where a regulated approach is undertaken, grid operators are in charge of the rollout. In those countries where the rollout is market-driven, energy suppliers or independent metering companies can be directly in charge of the meter installation. This is the case of the UK for instance.

With smart meters, consumers will benefit from enhanced knowledge of their energy consumption. Moreover, given the right conditions in place, it is expected that a number of improved customer services will allow individual households to make energy savings and financial savings.

Energy regulators and national legislators will, however, have to ensure the smooth implementation of the smart meter rollout through appropriate legislation.

The various **costs and benefits** connected to a large rollout of smart meters accrue to each stakeholder differently. Many stakeholders fear that the benefits will not be for those who bear the main cost of a smart meter rollout.

By and large, the main benefits identified are:
- The reduction of a number of operating costs;
- Improved functioning of market mechanisms;
- Increase of the security of supply;
- Energy savings.

Technology and infrastructure are going to incur the main costs for investors. As it is unclear if and to what extent financial benefits of the smart meter rollout will be passed on along the value chain, it is difficult to assess bearers of costs and benefits among actors.

Effect of smart meters on electricity prices and expenditures

The final effect of smart meters on electricity prices depends on the net costs and benefits to all market participants, and the **extent to which these are passed on** to the end-users.

In the initial phase of the rollout, the consumers will bear the costs, since most of the investment costs will be passed on to them. However in the long term, consumers are the ones who will reap the largest benefits, thanks to an overall reduction in energy expenditures.

In a liberalised market, it can be anticipated that many different tariffs will be offered to end-customers in a similar fashion to mobile and landline telephone tariffs. As a result, changes in tariffs offered based on competition, but also based on the demand response by the customers, are likely to result in a continuous dynamic development of tariffs structures and prices.

Time-of-Use tariffs, setting different prices for fixed times over the day, possibly differing for working days and weekends, present a limited risk of increased expenditures, but also have limited potential reward. In Italy, for instance, annual electricity expenditures with Time-of-Use tariffs equal single tariff expenditures if at least 67% of electricity consumption is during the off-peak hours. Since off-peak tariffs are applied 67% of the year, end-users need to actively shift their load to make actual financial savings.

With **Critical Peak Pricing tariffs**, combining time-of-use tariff elements with different prices for critical days which are selected by the electricity provider at short notice, French customers, for example, have managed to reduce their annual electricity expenditures by 10% in recent years. In the pilot trial preceding market introduction of the tariff, 59% of the customers also declared having made energy savings.

Real Time Pricing tariffs, which transmit price information to the customer in real time and allow the customer to respond by consuming more or less electricity, depending on the price at every time interval for which prices are fixed, offer the highest risk of increased expenditures and the highest potential for cost savings.

However, the simple introduction of smart meters will not be enough to foster energy savings. Defining target groups for specifically tailored interventions using different feedback channels as well as providing information on different levels of complexity and with different frequency etc. will have a major influence on the energy savings and load shifts achieved.

The electricity saving potential of smart meter implementation is difficult to quantify. Various trials conducted in Europe and internationally vary significantly in setup and local conditions. However, comparisons indicate that the electricity saving potential is of a low percentage and varies across households, the main influencing factors being the household size, the ecological priorities of the consumers, their typical behaviour and their consumption levels. Most notably, electric heating and air conditioning allow for a significant level of consumption reductions and load shifts.

Due to lack of data, it is difficult to make any final statement on the impact of smart meters on different income groups.

For private households, it is generally found that smaller households are more likely to save energy and that personal attitude towards energy savings is an important variable in influencing the final impact.

Concerning the impact on **low-income households**, extensive research has been carried out in the US, while there is great need for further analysis in Europe.

The US experiences show that since low-income households in general have flatter load shapes, they are more likely to benefit from flexible tariffs than from flat rates.

Effects of smart meters according to demand and supply patterns

The effects of smart meters are discussed for two different **energy mixes**, one based on conventional power plants and one with high shares of fluctuating renewable energies.

Under a conventional power regime it is found that:

- Short-term effect: reductions of the load during peak hours when power plants with high marginal costs operate will reduce spot market prices for these hours. Depending on the power plant park and the load level, such reductions can be significant. On the other hand, increasing load during off-peak hours will increase generation costs, but on a much lower level than the reductions during peak hours;

- Long-term effect: reduced overall generation prices reduce the income of all generators, thus reducing their contribution margin and incentive to invest.
- The main effects in a system dominated by renewable energies are the following:
- On average, wholesale electricity prices will decrease due to zero marginal costs of fluctuating renewables;
- Fluctuations in energy production may lead to a steep increase in prices during peak hours, and thus increase price fluctuations in general.

The usefulness of smart meters will depend on the demand patterns: for instance, without large consumer loads, load shifting and money savings are difficult to achieve.

The expected commercialisation of battery electric vehicles and hydrogen fuel cell electric vehicles will establish road transport fuels as additional electric demand. The intelligent dispatch of these additional loads will be necessary in order to allow for mass market introduction, and will represent an opportunity for the integration of increasing shares of fluctuating renewables in the grid.

Issues with smart metering and requirements for electricity produced on the consumers' premises

In the past, the large rollout of smart meters has led to public opposition from consumers, a problem that may also be encountered in future. In the cases of the Netherlands and the US, the main triggers were doubts about effective **data and privacy protection**.

The questions that will have to be answered by national legislators are: What data is collected and how often? Who is the owner of the data, who has access to it, how can it be processed and for what purposes? How can the communication infrastructure be built in such a way that the communication between the smart meter, the interface and the collecting entity is safe?

Health concerns related to the effects of exposure to electromagnetic fields have also triggered public resistance in the past and need to be taken into account when deploying smart meter infrastructure.

Recent research has shown that smart meter deployment may not always bring about the desired advantages, particularly in relation to energy savings. This may happen in case of **rebound**, **backfire** or **drawback effects**.

Concerning the rollout itself, the study shows that:

- Legislators have to avoid that the current lack of standardisation results in technology lock-ins for customers;
- Conflict of interests between policymakers and energy suppliers can be encountered as the former are attempting to promote energy efficiency while the latter rely on increasing their supply to increase their revenues;
- Lack of behavioural change and thus no increase in energy efficiency may come as a result of poor knowledge on the consumer side.

The requirement formulated in the draft Energy Efficiency Directive (EED)[1], enabling consumers producing energy on their premises to purchase a smart meter that can also account for the produced energy and the one exported to the grid, merely reinforces the need for standards and security measures (data, privacy, network).

[1] [COM(2011) 370 FINAL]

Conclusions and policy recommendations

At EU level, the study formulates some main recommendations:

- The current legal framework in terms of energy efficiency needs to be improved, as it may not be sufficient for achieving the 20% savings target. In this context, smart meters are an important first step to make consumption transparent but do not ensure energy savings on their own;
- Smart meters in combination with energy saving obligations for utilities may contribute to an uptake of energy efficiency services;
- The EU must ensure harmonised privacy provisions and should try to make stakeholders apply a "privacy-by-design" approach;
- The EU should make sure that future European standards, containing minimum technical functionalities, will be implemented;

The study also acknowledges that the draft **EED already takes into account many safeguards** formulated by academia to avoid unintended negative consequences that would be adverse to the energy efficiency objectives. For instance, the EED requires that **minimum technical functionalities** be set when implementing the directive and it ensures that consumers receive the service of smart metering **free of charge**. Also, annex VI prescribes an **interface** for smart meters, **secure communication** channels and acknowledges that the information exported through the interface is of **private** nature. An important detail is the fact that the text **differentiates** between data provided to the consumer via the interface and the one provided to the supplier, thereby providing a higher **privacy** level. Consumer trials demonstrate that access to **historical data** is important for consumer action, a fact that is also taken into account in annex VI. This is true also for making the displaying of the current **rate of consumption** and **related cost** mandatory.

For national legislators, the study suggests the following:

- Member States (MS) will have to define roles and responsibilities of all involved stakeholders;
- MS must ensure that privacy rules are implemented and can make use of additional voluntary measures;
- Communication and information activities will be crucial to ensuring acceptance and usage of smart meters;
- The optimal format in which energy consumption data will be provided on the interface and the bill will have to be assessed in each MS;
- MS will have to ensure safe communication;
- MS will have to assess the impact of the introduction of flexible tariffs on different consumer groups, especially on low-income households.

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